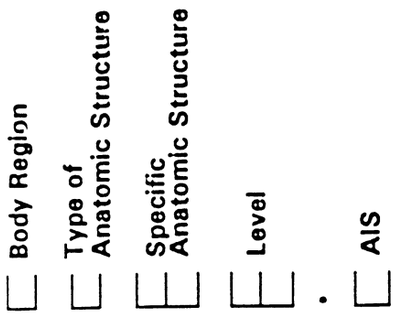
APPENDIX 1

THE AIS NUMERIC CODE

In AIS 90, each injury description is assigned a unique 6-digit numerical code in addition to the AIS severity score.



The following conventions are used in assigning the numerics to specific injury descriptions:

1. Body Region

1	Head
2	Face
3	Neck
4	Thorax
5	Abdomen
6	Spine
7	Upper Extremity
8	Lower Extremity
9	Unspecified

2. Type of Anatomic Structure

1	Whole Area
2	Vessels
3	Nerves
4	Organs (incl. muscles/lig.)
5	Skeletal (incl. joints)
6	Head - LOC

3. Specific Anatomic Structure or Nature

Whole Area

02	Skin - Abrasion
04	- Contusion
06	- Laceration
08	- Avulsion
10	Amputation
20	Burn
30	Crush
40	Degloving
50	Injury - NFS
60	Penetrating
90	Trauma, other than mechanical

Head - LOC

02	Length of LOC
04, 06, 08	Level of Consciousness
10	Concussion

Spine

02	Cervical
04	Thoracic
06	Lumbar

Vessels, Nerves, Organs, Bones, Joints are assigned consecutive two digit numbers beginning with 02.

4. Level

Specific injuries are assigned consecutive two-digit numbers beginning with 02.

To the extent possible, within the organizational framework of the AIS, 00 is assigned to an injury NFS as to severity or where only one injury is given in the dictionary for that anatomic structure. 99 is assigned to an injury NFS as to lesion or severity.

AIS Code	Description
1	Minor
2	Moderate
3	Serious
4	Severe
5	Critical
6	Maximum
9*	Unknown

General Coding Rules

Instructions are included throughout the AIS dictionary to help coders to make appropriate decisions concerning specific injury diagnoses. These are not repeated here. A number of coding principles, however, apply across body regions.

1. Injuries described as "probable," "possible," "impression of," or "rule out" should not be coded unless they are substantiated in the medical record.

2. Foreign bodies are not injuries and therefore are not coded.

3. The AIS does not assign codes to consequences of injury (e.g., blindness) but rather to the injury per se (e.g., optic nerve avulsion).

4. Surgical procedures and other treatment interventions should not be used to determine the severity of an injury.

5. AIS 6 is used only for injuries specifically assigned severity level 6 in the AIS. The use of AIS 6 is not an arbitrary choice simply because the patient died.

6. The "crush" injury description is used only when the injury meets the criteria in the dictionary.

7. Bilateral injuries are coded separately for organs such as the kidneys, eyes, ears, and extremities unless the dictionary specifically allows for coding as a single injury (e.g., lung injuries). Maxillae, mandibles, the pelvis and rib cage are coded as single structures.

8. An open fracture, by definition, means that the skin overlaying the fracture is lacerated. The external laceration is implicit in the code for open fracture and is not coded separately.

9. AIS 90 uses "not further specified" (NFS) to allow for coding injuries when detailed information is lacking.

   Injury unspecified means that an injury has occurred to a specific organ or body part, but the precise injury type is not known. For example, a kidney injury could be a contusion or a laceration, but this information may not be available. In this example, the kidney injury is coded as NFS. 99 is assigned to an injury NFS as to lesion or severity. [See Numerical Injury Identifier, page 4.]

   Severity unspecified means that a specfic injury (e.g., laceration) has occurred, but the level of severity is not specifically given or is unclear. In this example, the injury should be coded as laceration NFS. To the extent possible within the organizational framework of the AIS, 00 is assigned to an injury NFS as to severity. [See Numerical Injury Identifier, page 4.]

   Use of NFS should not be confused with code 9 which is assigned in those cases where trauma has occurred, but no information is available regarding specific organ or region. For example, "blunt abdominal trauma" is assigned a code 9.

10. If there is any question about the severity of an injury based upon all available documented information, code conservatively (i.e., the lowest AIS code in that injury's category).

RULES TO REMEMBER

HEAD

- Skull fracture + brain injury + LOC = code fracture and injury only

- LOC is coded only when no anatomical information exists, or in the rare instance when the LOC yields a higher severity than does the injury

- Self-reported LOC with no evidence of head injury and no EMS/medical personnel corroboration is disregarded

Neurological Deficits are not present pre-injury, and last more than a transient period (i.e., minutes):
  - hemiparesis, hemiplegia, weakness, sensory loss, hypesthesia
  - aphasia, dysphasia, facial weakness/palsy *(central)*
  - visual field defects, deviation of both eyes to one side, unequal pupils, fixed or non-reactive pupils (not due to eye injuries)

Clinical Signs of Basilar Skull Fracture (any of the following are sufficient evidence to code this injury):
  - hemotympanum, perforated tympanic membrane with blood in the canal
  - mastoid hematoma (battle signs), periorbital ecchymosis (raccoon's eyes)
  - CSF otorrhea/rhinorrhea

CHEST

- Lung laceration + Rib fracture + Hemo-pneumothorax = code the hemo-pneumo-thorax with the lung laceration, and rib fracture separately (*without* the hemo-pneumo)

- Rib fracture + Hemo-pneumothorax = code the hemo-pneumo with the rib fracture

- Hemo- and/or pneumothorax only = find code under Thoracic Cavity, only when no more specific anatomical information exists

ABDOMEN and PELVIC CONTENTS

- Retroperitoneal hemorrhage is coded only if it can be determined to be *unrelated* to thoracic or abdominal injuries already coded. Injuries *related* to retroperitoneal hemorrhage include:
  - injuries to the pancreas, duodenum, kidney, aorta, vena cava, mesenteric vessel
  - pelvic or vertebral fractures

- Lumbar spine injuries are found in Spine
- Rib cage injuries are found in Thorax
- Pelvis is found in Lower Extremities

SKIN

If the asterisked injury (or injuries):
- accompanies injury to a deeper structure = code in the actual body region
- is the only injury for the body region = find code under the body region, assign to External
- are minor, occur in multiple body regions, and are the only injuries = find single code for all injuries under External, assign to External

Estimating Blood Loss – A number of injuries to the skin, vessel lacerations, brain lesions, and internal organs are described in terms of blood loss by volume. The following table should help in assessing blood loss when information in the hospital chart is not specific, and in coding these injuries in children.

WEIGHT		20% BLOOD LOSS
POUNDS	KG	CC
220	100	1500
165	75	1125
110	50	750
55	25	375
22	10	150
11	5	75

DIAGRAM OF NINES

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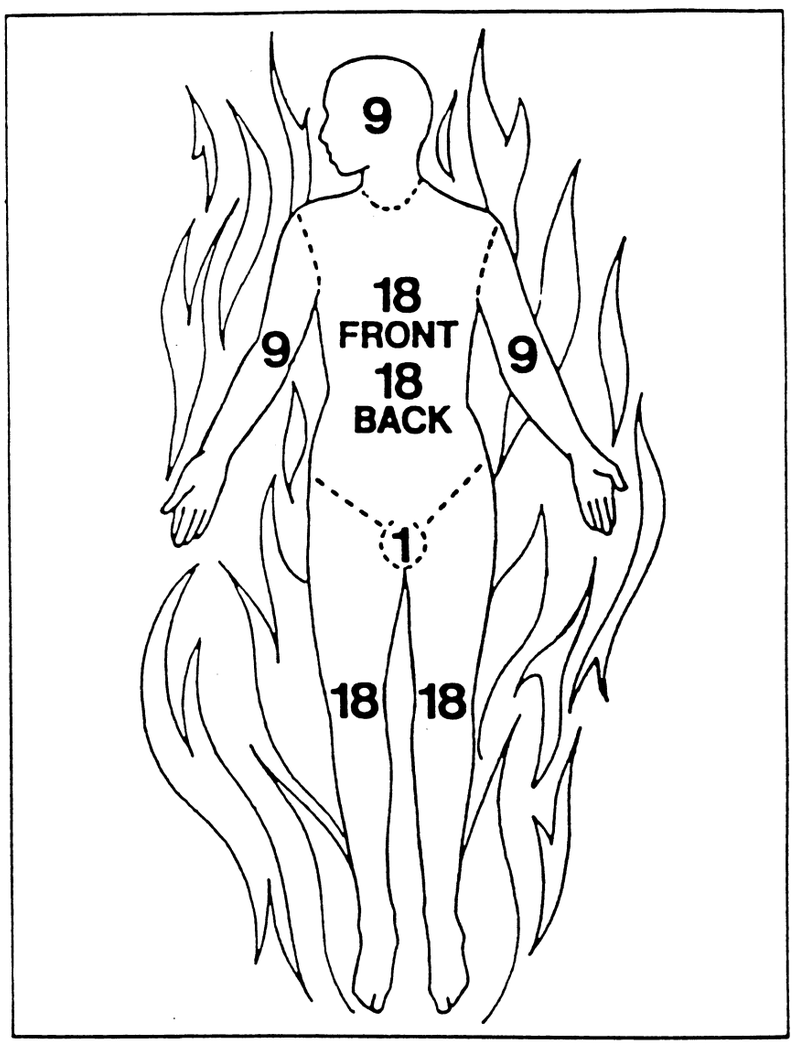

Abbreviated Injury Scale (AIS) and the Injury Severity Score (ISS)

1. Comparison of AIS dictionary sections with ISS body regions:

AIS Dictionary Sections	ISS Body Regions
1. Head 2. Neck	1. Head and neck *includes brain, skull, cervical spine and spinal cord*
3. Face	2. Face *includes mouth, ears, eyes, nose and facial bones*
4. Thorax	3. Chest *includes all internal thoracic organs, diaphragm, rib cage, and thoracic spine and spinal cord*
5. Abdomen/pelvic contents	4. Abdominal or pelvic contents *includes all internal abdominal organs, and lumbar spine and spinal cord*
6. Upper extremity 7. Lower extremity	5. Extremities and pelvic girdle *all sprains, fractures, dislocations and amputation - except for those of the spine, skull and rib cage*
8. Spine 9. Unspecified	6. External *lacerations, contusions, abrasions, and burns - independent of body region*

2. ISS Formula:

ISS = the *SUM* of the *SQUARES* of the *HIGHEST* AIS code in the three most severly injured ISS body regions

3. Example:

ISS body region	Injury	AIS code	Highest severity	AIS squared
HEAD/NECK	Cerebral contusion Complete transection of internal carotid	140602.3 320212.4	4	16
FACE	Ear laceration	210600.1	1	
CHEST	Rib fractures, ribs 3-4	450420.2	2	
ABDOMEN	Retroperitoneal hematoma	543800.3	3	9
EXTREMITIES	Femur fracture	851800.3	3	9
EXTERNAL	Overall abrasions	910200.1	1	
			ISS =	34

APPENDIX 2

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MEMORANDUM

Date: October 30, 1998

To: **Maya Mahue-Giangreco**
Injury and Violence Prevention program, Surveillance Section
County of Los Angeles, Department of Health Services

From: **Hope Seligson**

Copies: Charlie Huyck, Ron Eguchi

Subject: Northridge Earthquake Injury Data: Match to the Los Angeles County Assessor's and EQE/OES Damage Databases
(EQE Project Number: 250658.01)

Summary:

EQE International is pleased to provide to the County of Los Angeles, Department of Health Services (DHS), the results of the address match between the casualty data collected by DHS, and the Los Angeles County Assessor's Database and the EQE/OES Damage Database.

DHS provided location information on 3,436 injury records to EQE International to be matched against the complete Los Angeles County Assessor's Tax Roll for the year 1993. The results of this match are being returned to DHS along with pertinent structure information including: year built, construction class, square footage, etc. Matching efforts, utilizing automated matching as well as "hand-matching" and manual review, resulted in 2,049 matches (60%). However, a reduced amount (19%) of the injury records is considered "earthquake-related". The overall match rate for the earthquake-related injuries to Assessor's data is 71%. Table 1 presents a breakdown of match results by injury type.

In addition, the injury data was matched to the EQE/OES Damage Database developed during the Northridge Earthquake response. Information pertaining to the Building and Safety Inspections following the Northridge Earthquake are being supplied for 377 records (11% of total database, 18% of data matched to Assessor's database) which had an Assessor's Parcel Number assigned as a result of the Assessor Database match, and were subsequently matched to the damage database. The match rate for earthquake-related injuries is somewhat higher than the overall database, reaching 17%.

TABLE 1: Match Results by Injury Type

	Number of Records	Percent Match to Assessors Database	Percent Match to Assessors Database, Geocoded (w/ Lat & Long)
1 – Clearly EQ-related	237	76%	76%
2 – Not EQ-related	2783	57%	56%
3 – Assumed EQ-related	405	68%	65%
4 – Indirectly EQ-related	11	55%	55%
Total	3,436		

Results of the Los Angeles County Assessor's Tax Roll Address Match:

EQE International received 3,436 records collected by DHS. The database provided location information (i.e. street address) for injuries resulting from the Northridge Earthquake. The goal of this project was to match the data received from DHS to the Los Angeles County Tax Assessor's Roll, and the EQE/OES Damage Database, in order to identify the structure type and conditions where the respondent was located, and where the injury was reported to have taken place.

The DHS injury record data were attached to the Los Angeles County Assessor's Database, which contains approximately 2.25 million parcel records. The results of the address match allowed EQE to develop a table that contains all of the site-specific information from the County Assessor's Tax Rolls. Overall, nearly 60% of the total number of records supplied were matched to an address within the Los Angeles County Tax Assessor's Roll. Table 2 defines the fields provided from the Assessor's data, and the gives a brief description of the field contents. EQE is providing the data in an Excel file entitled DHS_ASSR.XLS (Table: *DHS Assessor Damage Match).*

Condominiums:

While the majority of matches resulted in the selection of unique parcel sites, 112 street address matches resulted in the selection of multiple parcels. These records are denoted with a "Match Flag" of 2 (condominiums) or 3 (split parcels). Most of these multiple matches (90) actually represent condominium buildings[1], and aggregation of the key fields (i.e., square footage and number of units) results in a reasonable representation of the actual building. For each condominium record, the "Square Footage Building" represents the aggregated area of all units within the building. "Square Footage Unit" represents the actual area of the unit in question (when unit number was provided with the injury data) or a representative unit area (when the unit number was not provided with the injury data). For non-condominium structures, "Square Footage Unit" and "Square Footage Building" are equal. Condominium buildings represented in the current database range from 4 unit buildings with approximately 3600 square feet of floor space, to buildings with more than 200 units and

[1] Note: The Los Angeles County Tax Assessor assigns each condominium a unique parcel number for tax purposes. For condominiums that have a common street address and unit numbers, multiple matches will ensue. For condominiums, which have unique street addresses, only the unit in question will appear.

more than 200,000 square feet of floor space. The remaining multiple matches resulted from other issues, such as split parcels.

Please note that some condominium units are given a unique street address. In this case, the address match will not return multiple parcels; rather the results will be the return of the singular condominium unit.

Results of the EQE/OES Damage Database Parcel Number Match:

Once the injury data had been matched to the Los Angeles County Tax Assessor's Roll, it was possible to refer to the Northridge Earthquake damage database developed by EQE International and the Governor's Office of Emergency Services. This database represents the best compilation of Building and Safety Inspection records from many of the local jurisdictions directly impacted by the earthquake. The damage database contains nearly 115,000 distinct Building and Safety damage inspection records. Each of these inspection records had previously been address matched to the Los Angeles County Tax Rolls, and the parcel number recorded. Of the 2,049 addresses matched to the County Tax Rolls, 18% (377 records) appeared in the damage database. Pertinent damage information for these 377 records is therefore being made available DHS, including: OES Damage ID, Building and Safety Placard (tag), estimated damage, and estimated percent damage. See Table 2 for field definition and description.

Reference Maps:

EQE International is pleased to provide two Geographic Information Systems (GIS) maps which present the DHS injury data in relation to the ground shaking from the Northridge Earthquake. To develop these maps, EQE utilized the latitude and longitude from the Tax Assessor's database, when available. In this manner, EQE was successful in obtaining a latitude and longitude for 59% (2,011 records) of the complete DHS injury database, and 69% of the earthquake-related injury records (449 records).

The first map shows the official Modified Mercalli Intensities (MMI) for the Northridge Earthquake, developed by the USGS (Dewey, 1995), overlain with the DHS Injury database. Likewise, the DHS Injury data were placed over the contours of Log of PGA developed by OES-GIS using uncorrected data from the U.S. Geologic Survey (USGS) and the California Division of Mines and Geology (CDMG), as documented in the EQE/OES Northridge Earthquake Report of Data Collection and Analysis , Part A (EQE/OES, 1995).

Three additional map views will be developed to provide a more detailed look at selected areas with high concentrations of injuries. These areas will be identified with consultation from DHS.

References:

Dewey, J.W., B.G. Reagor, L. Dengler, and K. Moley (1995). "Intensity Distribution and Isoseismal Maps for the Northridge, California, Earthquake of January 17, 1994," U.S. Geological Survey Open-File Report 95-92.

Evernden, J.F. and J.M. Thomson, (1988), "Predictive Model for Important Ground Motion Parameters Associated with Large and Great Earthquakes," United States Geological Survey Bulletin 1838.

EQE International, Inc. and the Governor's Office of Emergency Services (1995). The Northridge Earthquake of January 17, 1994: Report of Data Collection and Analysis, Part A: Damage and Inventory Data, Irvine, California

Attachments: Los Angeles County Assessor's Tax Roll Use Code Definitions
Evernden Soil Code Definitions
Modified Mercalli Intensity Map for the Northridge Earthquake
Contours of Log of Peak Ground Acceleration for the Northridge Earthquake

Table 2

DHS Address Match Database - Field Definition and Description

Field Name	Description
ENTNUM	DHS's Unique Identifier.
ADD_NUM	Address Number provided by DHS.
ADD_DIR	Street Direction (compass Direction) provided by DHS.
ADD_NAME	Street Name provided by DHS.
ADD_STYP	Street Suffix provided by DHS.
ADD_APT	Apartment or unit number (where applicable) provided by DHS.
CITY	City or community name provided by DHS.
LEGAL_CITY	The legal name for the City (or the name of the city in which the community resides) (i.e. Northridge is within the City of Los Angeles).
LEGAL_CNTY	The legal name for the County.
ZIP	Zip Code provided by DHS.
FULL_ADD	Full Address provided by DHS.
Earthquake	Code indicating whether the injury was earthquake-related, provided by DHS (1=earthquake-related, 2 = not earthquake-related, 5 = assumed earthquake-related, and 9=indirectly earthquake related)
FaclCode	Facility code indicating hospital provided by DHS.
TIMEPD	Code indicating time of injury provided by DHS.
ISS	Code indicating injury severity provided by DHS.
Parcel Number	Tax Assessor Roll Number for each situs.
Situs Address	Assessor's street address for the parcel.
Situs Zip Code	Parcel Zip Code.
Use Code	This code differentiates the major use of the parcel (Residential, Commercial) and the detailed use within the parcel (Single Family, Duplex, Service Station, etc.). Attachment I provides a complete listing of use definitions.
Structure Type	This field identifies the generalized construction of the improvement. A=Steel Frame B= Concrete Frame C= Block/Brick/Other Concrete D= Wood Frame

Table 2

DHS Address Match Database - Field Definition and Description

Field Name	Description
ENTNUM	DHS's Unique Identifier.
ADD_NUM	Address Number provided by DHS.
ADD_DIR	Street Direction (compass Direction) provided by DHS.
ADD_NAME	Street Name provided by DHS.
ADD_STYP	Street Suffix provided by DHS.
ADD_APT	Apartment or unit number (where applicable) provided by DHS.
CITY	City or community name provided by DHS.
LEGAL_CITY	The legal name for the City (or the name of the city in which the community resides) (i.e. Northridge is within the City of Los Angeles).
LEGAL_CNTY	The legal name for the County.
ZIP	Zip Code provided by DHS.
FULL_ADD	Full Address provided by DHS.
Earthquake	Code indicating whether the injury was earthquake-related, provided by DHS (1=earthquake-related, 2 = not earthquake-related, 5 = assumed earthquake-related, and 9=indirectly earthquake related)
FaclCode	Facility code indicating hospital provided by DHS.
TIMEPD	Code indicating time of injury provided by DHS.
ISS	Code indicating injury severity provided by DHS.
Parcel Number	Tax Assessor Roll Number for each situs.
Situs Address	Assessor's street address for the parcel.
Situs Zip Code	Parcel Zip Code.
Use Code	This code differentiates the major use of the parcel (Residential, Commercial) and the detailed use within the parcel (Single Family, Duplex, Service Station, etc.). Attachment I provides a complete listing of use definitions.
Structure Type	This field identifies the generalized construction of the improvement. A=Steel Frame B= Concrete Frame C= Block/Brick/Other Concrete D= Wood Frame

Table 2 (Continued)
DHS Address Match Database - Field Definition and Description

Field Name	Description
Tag	The Building and Safety Placard applied to an inspected structure. g=Green Tag (Safe to Occupy) y=Yellow Tag (Limited Access Only) r=Red Tag (Unsafe) u=Unknown Placard (Placard not identified to OES when reported).
Estimated Damage	Building and Safety Inspector's estimated damage in terms of repair cost, when available.
Percent Damage	Percent damage to the structure estimated by the Building and Safety Inspector, when available.

MEMORANDUM
2/10/99

Attachment I

Los Angeles County Assessor's Tax Roll Use Code Definitions

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PROPERTY USE CLASSIFICATION CHART

0000 RESIDENTIAL

00 (OPEN)

010V VACANT LAND

01 SINGLE

3rd digit-0 4th digit
1=Pool
4=Therapy Pool
C=Condominium
D=Planned Res Development
E=Condo Conversion
F=Cooperative
H=Own-Your-Own

02 DOUBLE, DUPLEX, OR TWO UNITS

03 THREE UNITS (ANY COMBINATION)

04 FOUR UNITS (ANY COMBINATION)

05 FIVE OR MORE APARTMENTS OR UNITS. COOPERATIVES OR OWN-YOUR-OWN PROJECTS NOT SEPARATELY PARCELLED.

3rd digit 4th digit
0=4 Stories or less 1=Pool
9=Other Improvements Only
5=5 Stories or more
A=Cooperative
B=Own-Your-Own
C=Condominium
M=Modular

06 MODULAR HOMES

3rd digit 4th digit
0=Single Residence 0=None
1=Multiple Residence 1=Pool
4=Therapy Pool
C=Condominium
D=Planned Res. Development

07 MOBILE HOMES

3rd digit 4th digit
0=Single Residence 0=Assessed by RP (Permanent fdn.)
1=Multiple Residence P=Assessed by PP (No Permanent fdn.)

08 ROOMING HOUSES

09 MOBILEHOME PARKS

3rd digit-0 4th digit
1=Pool

1000 *COMMERCIAL

10 (OPEN)

100V VACANT LAND

10 COMMERCIAL

3rd digit
0=Open
1=Miscellaneous Commercial
2=Artist in Residence

1100 STORES

12 STORE COMBINATION (WITH OFFICE OR RESIDENTIAL)

3rd digit
0=Store & Office Combination
1=Store & Residential Combination

13 DEPARTMENT STORES

3rd digit
1=Discount Department Stores
2=Building Supplies (Builders Emporiums, etc.)
3=Home Furnishings (Barker Brothers, etc.)
4=Retail-Warehouse Combination (Levitz)
5=Warehouse Store (Price Club, etc.)

14 SUPERMARKETS

3rd digit
0=Supermarket- 12000# or more
1=Supermarket- 6000# through 11999#
2=Small Food Stores- Less than 6000#

15 SHOPPING CENTERS (NEIGHBORHOOD, COMMUNITY)

16 SHOPPING CENTERS (REGIONAL)

17 OFFICE BUILDINGS

3rd digit
1=Loft type Buildings
2=Office and Residential

18 HOTEL AND MOTELS

3rd digit
0=Hotels- under 50 rooms
1=Hotels- 50 rooms and over
2=Motels- under 50 units
3=Motels- 50 units and over
4=Motel/Hotel and Apartment Combinations- Under 50 units
5=Motel/Hotel and Apartment Combinations- 50 units and over

19 PROFESSIONAL BUILDINGS

3rd digit
1=Medical Dental Building
2=Veterinary Hospitals, Clinics

2000 *COMMERCIAL

20 (OPEN)

21 RESTAURANTS, COCKTAIL LOUNGES

3rd digit
0=Restaurants, Cocktail Lounges, Taverns
1=Fast Food- Walk Up
2=Fast Food- Auto Oriented

22 WHOLESALE AND MANUFACTURING OUTLETS

23 BANKS, SAVINGS & LOANS

24 SERVICE SHOPS
RADIO & T.V. REPAIR
REFRIGERATOR SERVICE
PAINT SHOPS
ELECTRIC REPAIR
LAUNDRIES

25 SERVICE STATIONS

3rd digit
0=Full Service
1=Self Service
2=Station with Car Wash

26 AUTO, RECREATION EQPT., CONSTRUCTION EQPT., SALES & SERVICE

3rd digit
0=Auto Service Shops (Body & Fender Commercial Garage)
1=Used Car Sales
2=New Car Sales & Service
3=Car Wash
4=Car Wash - Self Service Type
5=Recreation Equipment Sales & Service (Campers, Motor Homes, Boats)
6=Farm and Construction Equipment Sales & Service
7=AUTO SERVICE CENTERS (NO GASOLINE)

27 PARKING LOTS (COMMERCIAL USE PROPERTIES)

3rd digit
0=Lots-patron or Employee
1=Lots-Commercial parking
2=Parking Structures- Patron or Employee
3=Parking Structures- Commercial parking

28 ANIMAL KENNELS

29 NURSERIES OR GREENHOUSES

*For improved properties, 4th digit describes the number of stories in the main structure (with the exception of lifts or condominiums). See Section 4.3 B.

2 thru 5= to indicate the # of stories from 2 thru 5
6=to indicate 6 thru 13 stories
7= to indicate 14 thru 20 stories
8=to indicate 21 thru 30 stories
9= to indicate over 30 stories
C=Condominiums
L=Lift (entered by Lift Desk Section ONLY)

NOTE: The 2nd digit "G" in 0100 through 0900 series indicates "Lifted" improvements.

PROPERTY USE CLASSIFICATION CHART

3000 *INDUSTRIAL

30 (OPEN)

300V VACANT LAND

30 INDUSTRIAL
3rd digit
0=Open
1=Miscellaneous Industrial
2=Artist in Residence

31 LIGHT MANUFACTURING
SMALL EQUIPMENT MANUFACTURING
SMALL MACHINE SHOPS
INSTRUMENTS MANUFACTURING
PRINTING PLANTS

32 HEAVY MANUFACTURING

33 WAREHOUSING, DISTRIBUTION, STORAGE
3rd digit
0=Warehousing,Distribution under 10,000≠
1=Warehousing,Distribution 10,000≠ 24,999≠
2=Warehousing,Distribution 25,000≠ through 50,000≠
3=Warehousing,Distribution over 50,000≠
4=Public Storage (Beking,Lyons)
5=Public Storage-Mini Warehouse

34 FOOD PROCESSING PLANTS
3rd digit
0=Meat
1=Beverage
2=Other

35 MOTION PICTURE,RADIO AND TELEVISION INDUSTRIES
3rd digit
0=Studios
1=Transmission Facilities
2=Microwave Relay Towers

36 LUMBER YARDS

37 MINERAL PROCESSING
3rd digit
1=Cement,Rock & Gravel Plants
2=Petroleum Refineries, Chemical Plants

38 PARKING LOTS (INDUSTRIAL USE PROPERTIES)

39 OPEN STORAGE
3rd digit
1=Trucking Companies, Terminals
2=Contractor Storage Yards

4000 IRRIGATED FARM

40 (OPEN)

4010 PRIVATE RURAL PUMPING PLANT

41 FRUITS & NUTS

42 VINEYARDS

43 VINE & BUSH FRUITS

44 TRUCK CROPS

45 FIELD CROPS

46 PASTURE

47 DAIRIES

48 POULTRY, ETC.

49 FEED LOTS

5000 DRY FARMS

50 (OPEN)

51 FRUITS & NUTS

52 VINEYARDS

53 FIELD CROPS

54 PASTURE

55 TIMBER - PINE

56 TIMBER - FIR

57 TIMBER - REDWOOD

58 DESERT

59 WASTE

6000 *RECREATIONAL

60 OPEN

61 THEATERS
3rd digit
0=Movie- Indoor
1=Movie- Drive-In
2=Legitimate Theater

62 WATER RECREATION
3rd digit
1=Fee Owned Boat Slip

63 BOWLING ALLEYS

64 CLUBS, LODGE HALLS,FRATERNA ORGANIZATIONS

65 ATHLETIC AND AMUSEMENT FACILITIES
3rd digit
0=Auditoriums, Stadiums Amphitheaters
1=Amusement Facilities
2=Commercial Swimming Pools Schools
3=Gymnasiums, Health Spas
4=Dance Halls
5=Tennis Courts, Clubs Pro Shops

66 GOLF COURSES
3rd digit
1=Non Profit
2=Three par
3=Miniature

67 RACE TRACKS
3rd digit
1=Horse Stable- Private

68 CAMPS
3rd digit
1=Trailer and Camper Parks (overnight)

69 SKATING RINKS
3rd digit
0=Ice
1=Roller

*For improved properties, 4th digit describes the number of stories in the main structure (with the exception of lifts or condominiums).
See Section 4.3 B

0=one Storey
2 thru 5=to indicate the # of stories from 2 thru 5
6=to indicate 6 thru 13 stories
7=to indicate 14 thru 20 stories
8=to indicate 21 thru 30 stories
9=to indicate over 30 stories

PROPERTY USE CLASSIFICATION CHART

7000 *INSTITUTIONAL	
70	(OPEN)
71	CHURCHES 3rd digit 1=Church Parking Lots
72	SCHOOLS (PRIVATE)
73	COLLEGE, UNIVERSITIES (PRIVATE)
74	HOSPITALS 3rd digit 1=Convalescent Hospitals, Nursing Homes
75	HOMES FOR AGED & OTHERS
76	OPEN
77	CEMETERIES,MAUSOLEUMS,MORTUARIES 3rd digits 0=Cemeteries,Mausoleums 1=Mortuaries,Funeral Homes
78	OPEN
79	OPEN
*	For improved properties, 4th digit describes the number of stories in the main structure (with exception of lifts or condominiums). See Section 4.3 B.

8000 MISCELLANEOUS	
80	OPEN
81	UTILITY COMMERCIAL & MUTUAL: PUMPING PLANTS STATE ASSESSED PROPERTY
82	MINING
83	PETROLEUM & GAS
84	PIPELINE, CANALS
85	RIGHT OF WAY
86	WATER RIGHTS
87	RIVERS & LAKES

8000 GOVERNMENT OWNED PROPERTIES ("900" PARCELS)	
8800	(OPEN)
880V	VACANT LAND
8810	Rights of Way, General
8811	Streets, Road, Highway
8812	Future Street,Alley, etc.
8813	Power Transmission Lines
8814	Sewers, Utilities
8820	Government Services, General
8821	City Hall, Administration Center
8822	Auxiliary and Regional Center
8823	Police and Fire Station
8824	Utilities Office (Power,Water,etc.)
8825	Welfare and Social Services
8826	Postal Facility
8827	Library
8828	Court Building, Jail
8829	Military Post
8830	Public School,General
8831	College
8832	High School
8833	Elementary School
8834	School Administration Center
8835	School Service Center
8840	Recreation,General
8841	Public park
8842	Art Center,Museum
8843	Public Swimming Pool
8844	Sports Stadium
8845	Beach
8846	Horse Stable
8847	Amusement Ride
8848	Ball Field (Little League,etc.)
8849	Youth Facility (Scouts,etc.)
8850	Water Related Facilities,General
8851	Small Boat Marina
8852	Boat Slip
8853	Boat Mooring
8854	Pier,Wharf
8855	Flood Control Drainage
8856	Irrigation - Related
8857	Dam
8858	Reservoir, Tank Underground Storage
8859	Watershed
8860	Transportation,General
8861	Harbor & Related
8862	Airport, General
8863	Airport,T Hanger
8864	Airport,Tie - Down
8865	Airport,Fixed - Based Operator
8866	Rapid Transit,Bus,etc.
8870	Concession on Public Property
8871	Food Concession
8872	Souvenir Shop
8873	Parking Lot Lease
8874	Office Space Lease
8890	Community Redevelopment
8891	Public Housing
8899	Government Property and Possessory Interest Not Classified in Any of Above
8900	Dump Sites

*For improved properties, 4th digit describes the number of stories in the main structure (with exception of lifts or condominiums).

0=one story
2 thru 5 indicate the # of stories from 2 thru 5
6=to indicate 6 thru 13 stories
7=to indicate 14 thru 20 stories
8=to indicate 21 thru 30 stories
9=to indicate over 30 stories

MEMORANDUM
2/10/99

Attachment II
Evernden Soil Code Definitions

Soil Code	Site Geology
A	Granitic and Metamorphic Rock
B	Paleozoic Sedimentary Rock
C	Early Mesozoic Sedimentary Rock
D	Cretaceous-Eocene Sedimentary Rock
E	Undivided Tertiary Sedimentary Rock
F	Oligocene-Pliocene Sedimentary Rock
G	Pliocene/Pleistocene Sedimentary Rock
H	Tertiary Volcanic Rock
I	Quaternary Volcanic Rock
J	Quaternary Sedimentary Deposits (Shallow Groundwater)
K,L,M	Other Quaternary Sedimentary Deposits

APPENDIX 3

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MEMORANDUM

Date: March 4, 1999

From: Hope Seligson, EQE International

To: Maya Mahue-Giangreco
Injury and Violence Prevention Program, Surveillance Section
County of Los Angeles, Department of Health Services

Copies: **Ron Eguchi, EQE International**

Subject: **Delivery of Revised Final Report for LA Co. DHS/USGS Northridge Earthquake Injury Research Project (EQE Project #: 250658.01)**

Attached you will find an updated copy of the main body of the February 16 final report, which incorporates your comments and corrections. Please note that I have not included the figures and attachments, which have not changed. Feel free to call should you have any questions.

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February 16, 1999

Maya Mahue-Giangreco
Injury and Violence Prevention Program, Surveillance Section
COUNTY OF LOS ANGELES, DEPARTMENT OF HEALTH SERVICES
313 N. Figueroa Street, Room 127
Los Angeles, California 90012

Subject: *Final Report: Los Angeles County Northridge Earthquake Hospital Injury Database Enhancement and Analysis. EQE Project Number: 250658.01*

Dear Maya:

EQE International is pleased to provide to the County of Los Angeles, Department of Health Services (DHS), the results of the Northridge earthquake hospital injury database enhancement and analysis. The principle intent of this project was to determine available building and building damage data corresponding to locations of documented injuries in the Northridge earthquake. The major tasks of the project included:

- Performing address review and matching of 3,436 hospital records from the Los Angeles County DHS injury database to the Los Angeles County Assessor's database and the OES/GIS Northridge Earthquake Inspection database. This database included baseline injury scene addresses prior to the earthquake, as well as earthquake-related injuries.

- Association of matched addresses with Northridge ground motion maps (Modified Mercalli Intensity and peak ground acceleration) and development of 8-1/2" x 11" color regional ground motion maps for presentation. In addition, smaller scale maps of heavily impacted service planning areas were also developed.

- Limited comparison of documented earthquake-related injuries from the LA County injury database to injury models used in EPEDAT. (EPEDAT is the Early Post-Earthquake Damage Assessment Tool, real-time earthquake loss assessment software developed by EQE for the California Office of Emergency Services). The goal of this sub-task was to plot Northridge injury data relative to existing casualty estimation models.

INTRODUCTION

Following the Northridge Earthquake, a diverse group of researchers created a small consortium to document and study earthquake-related injury data. The researchers included epidemiologists form the Los Angeles County Department of Health Services and the Southern California Injury Prevention Research Center at UCLA, public health

researchers from what would shortly become the Center for Public Health and Disaster Relief at UCLA, and engineers specializing in loss estimation from EQE International. The general goal of the research was to capture perishable data on injuries and deaths caused by the earthquake, as well as identify factors contributing to the risk of injury. Further, it was hoped that by integrating data on injuries and deaths with earthquake hazard and building damage data, we would advance the state-of-the-art and better quantify injury risk in future earthquakes.

From the perspective of engineering-based loss estimation, there is room for much improvement in the estimation of earthquake-related injuries. Current models, based on data from previous earthquakes, relate generic injury rates to building damage states (described by a range of damage, e.g., 10 - 30%), regardless of building construction. It is our hope that additional in-depth study of injuries in earthquakes, such as Northridge, will allow researchers to refine existing injury models and facilitate improved estimates of casualties in future earthquakes. The current study represents the first steps to such an improvement: systematically analyzing injury data relative to earthquake hazard parameters and building construction information.

1.0 ADDRESS MATCH RESULTS

DHS provided location information on 3,436 injury scenes to EQE International to be matched against the complete Los Angeles County Assessor's Tax Roll for the year 1993. The injury database included baseline injury data for the two weeks prior to the earthquake ("pre-earthquake"), in addition to data for the two weeks following the earthquake ("post-earthquake"). Post-earthquake injuries have been further categorized by DHS, to identify whether they were earthquake-related. Matching efforts were concentrated on those injuries identified as post-earthquake and earthquake-related. The results of the address match were returned to DHS, along with pertinent structure information including year built, construction class, square footage, etc. In addition, geocoding information (latitude and longitude) was available for 98% of matching records. The distribution of DHS injury data, and the results of the address match, are summarized in Table 1. As shown in the table, matching efforts, utilizing automated matching as well as "hand-matching" and manual review, resulted in 2,049 matches (60%). However, a reduced number of the injury records (650 records, or 19%) are considered "earthquake-related" (denoted with an asterisk in Table 1), and the match rate on these records was higher than the overall match rate, reaching approximately 71%.

In addition, the injury data were matched to the EQE/OES Damage Database developed during the Northridge Earthquake response. Information pertaining to the Building and Safety Inspections following the Northridge Earthquake have been supplied to DHS for 377 injury records that had an Assessor's Parcel Number assigned as a result of the Assessor Database match, and were subsequently matched to the damage database. Of these 377 records, 64% (242) are associated with the post-earthquake injury records. The damage database match results for post-earthquake, earthquake-related injuries totaled 108 matches (24% of post-earthquake, earthquake-related injuries matched to the Assessor's database, and 17% of all post-earthquake, earthquake-related injuries).

Table 1: DHS Injury Data

Time Period	Earthquake-Related (ER)	Number of Records	Address Match Results to Assessor's Database	Percent Matched to Assessor's Database	Match Results for OES/EQE Damage Data
Pre-Earthquake	Clearly ER	3	3	100%	0
Pre-Earthquake	Not ER	1,261	834	66%	135
Pre-Earthquake Sub-Total		1,264	837	66%	135
Post-Earthquake	Clearly ER*	234	178	76%	38
Post-Earthquake	Not ER	1,522	753	49%	134
Post-Earthquake	Assumed ER*	405	275	68%	68
Post-Earthquake	Indirectly ER*	11	6	55%	2
Post-Earthquake Sub-Total		2,172	1,212	56%	242
TOTAL		3,436	2,049	60%	377

Note: * = Post-earthquake injuries considered to be "earthquake-related", and the focus of the present analysis.

1.1 ADDRESS MATCH TO THE LOS ANGELES COUNTY ASSESSOR'S DATABASE:

The database provided by DHS indicated location information (i.e. street address) for injuries resulting from the Northridge Earthquake. The goal was to match the data received from DHS to the Los Angeles County Tax Assessor's Roll and the EQE/OES Damage Database, to identify the structure type and conditions where the injury was reported to have taken place.

The address information in the DHS injury data was compared to the Los Angeles County Assessor's Database, which contains approximately 2.25 million parcel records. The results of the address match allowed EQE to develop a table that contained the site-specific information from the County Assessor's Tax Rolls for each reported injury location. Overall, nearly 60% of the total number of injury records supplied were matched to an address within the Los Angeles County Tax Assessor's Roll. Table 2 defines the fields provided from the Assessor's data, and gives a brief description of the field contents. In addition, a variety of geographic data previously associated with the parcel was also provided, including Modified Mercalli Intensity and peak ground acceleration experienced in the Northridge Earthquake, local soil conditions, census tract, and census block group. EQE has provided the data in an Excel file entitled DHS_ASSR.XLS (Table: *DHS Assessor Damage Match).*

1.1.1 Condominiums:

While the majority of matches resulted in the selection of unique parcel sites, 112 street address matches resulted in the selection of multiple parcels. These records are denoted with a "Match Flag" of 2 (condominiums) or 3 (split parcels). Most of these multiple matches (90) are associated with condominium buildings[1], and aggregation of the key fields for all units within the identified structure (i.e., square footage and number of units) results in a reasonable representation of the building. For each condominium record, the "Square Footage Building" represents the aggregated area of all units within the building. "Square Footage Unit" represents the actual area of the unit in question (when unit number was provided with the injury data) or a representative unit area (when the unit number was not provided with the injury data). For non-condominium structures, "Square Footage Unit" and "Square Footage Building" are equal. Condominium buildings represented in the current database range from 4 unit buildings with approximately 3600 square feet of floor space, to buildings with more than 200 units and more than 200,000 square feet of floor space. The remaining multiple matches resulted from other issues, such as split parcels.

It should be noted that some condominium units are given a unique street address. In this case, the address match will not return multiple parcels; rather the results will be the return of the singular condominium unit.

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[1] Note: The Los Angeles County Tax Assessor assigns each condominium a unique parcel number for tax purposes. For condominiums that have a common street address and unit numbers, multiple matches will ensue. For condominiums, which have unique street addresses, only the unit in question will appear.

Table 2: DHS Address Match Database - Field Definition and Description

Field Name	Description
ENTNUM	DHS's Unique Identifier.
ADD_NUM	Address Number provided by DHS.
ADD_DIR	Street Direction (compass Direction) provided by DHS.
ADD_NAME	Street Name provided by DHS.
ADD_STYP	Street Suffix provided by DHS.
ADD_APT	Apartment or unit number (where applicable) provided by DHS.
CITY	City or community name provided by DHS.
LEGAL_CITY	The legal name for the City (or the name of the city in which the community resides) (i.e. Northridge is within the City of Los Angeles).
LEGAL_CNTY	The legal name for the County.
ZIP	Zip Code provided by DHS.
FULL_ADD	Full Address provided by DHS.
Earthquake	Code indicating whether the injury was earthquake-related, provided by DHS (1=earthquake-related, 2 = not earthquake-related, 5 = assumed earthquake-related, and 9=indirectly earthquake related)
FaclCode	Facility code indicating hospital provided by DHS.
TIMEPD	Code indicating time of injury provided by DHS.
ISS	Code indicating injury severity provided by DHS.
Parcel Number	Tax Assessor Roll Number for each situs.
Situs Address	Assessor's street address for the parcel.
Situs Zip Code	Parcel Zip Code.
Use Code	This code differentiates the major use of the parcel (Residential, Commercial) and the detailed use within the parcel (Single Family, Duplex, Service Station, etc.). Attachment I provides a complete listing of use definitions.
Structure Type	This field identifies the generalized construction of the improvement. A=Steel Frame B= Concrete Frame C= Block/Brick/Other Concrete D= Wood Frame
Year Built	Year the improvement was constructed.
Number of Units	Number of Residential Units, or office units in the improvement.
Square Footage Unit	This field identifies the actual square footage for single family dwellings and other non-condominium buildings, and TYPICAL square footage of a unit within the improvement for condominiums. Please refer to text in this memo that further describes the method of handling condominiums.
Square Footage Building	This field contains the total square footage for the improvement. This number should equal the Unit Square Footage for Single Family Dwellings and other non-condominium buildings.
Latitude	Latitude of parcel
Longitude	Longitude of parcel

Table 2: DHS Address Match Database - Field Definition and Description (Cont.)

Field Name	Description
Evernden Soil Code	Evernden Regional Soils applied to the County Assessor's Tax Rolls by EQE/OES. See Attachment II for soil code definitions (Evernden, 1988)[2]
MMI Value	The USGS Modified Mercalli Intensity (MMI) as mapped for the parcel in question. This value represents the shaking intensity experienced at the improvement. (Dewey, 1995)[3]
Census Tract	The 1990 Census tract the parcel resides in. This is supplied to allow for the application of Census data.
Census Block Group	The 1990 Census Block Group for the parcel.
Log(PGA) - Interpolated Value	Value of Log(pga) interpolated between contours as drawn by OES-GIS (EQE/OES, 1995).
Interpolated PGA Value	PGA (in units of g) computed from interpolated Log(PGA), above.
Street Number	Situs Street Number from the Assessor's File.
Street Direction	If included in the street name, the compass orientation of the street (North, South, East, West, etc.).
Street Name	Situs Street Name from the Assessor's File.
City from Assessor	Situs City Name from the Assessor's File.
Match Flag	The type of match resulting from the Assessor's File. 1= A unique match on address 2 = A match to multiple parcels (Condominiums) 3 = A match to multiple parcels which were distinct and unique (split parcels)
OES Damage ID	A unique identifier relating the Assessor's Parcel data to the OES Damage Database.
Tag	The Building and Safety Placard applied to an inspected structure. g=Green Tag (Safe to Occupy) y=Yellow Tag (Limited Access Only) r=Red Tag (Unsafe) u=Unknown Placard (Placard not identified to OES when reported).
Estimated Damage	Building and Safety Inspector's estimated damage in terms of repair cost, when available.
Percent Damage	Percent damage to the structure estimated by the Building and Safety Inspector, when available.

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[2] Evernden, J.F. and J.M. Thomson, (1988), "Predictive Model for Important Ground Motion Parameters Associated with Large and Great Earthquakes," *United States Geological Survey Bulletin 1838.*

[3] Dewey, J.W., B.G. Reagor, L. Dengler, and K. Moley (1995). "Intensity Distribution and Isoseismal Maps for the Northridge, California, Earthquake of January 17, 1994," *U.S. Geological Survey Open-File Report 95-92.*

1.2 Address Match to the EQE/OES Damage Database:

Once the injury data had been matched to the Los Angeles County Tax Assessor's Roll, it was possible to refer to the Northridge Earthquake damage database developed by EQE International and the Governor's Office of Emergency Services. This database represents the best compilation of Building and Safety Inspection records from many of the local jurisdictions directly impacted by the earthquake. The damage database contains nearly 115,000 distinct Building and Safety damage inspection records. Each of these inspection records had previously been address matched to the Los Angeles County Tax Rolls, and the parcel number recorded. Of the 2,049 addresses matched to the County Tax Rolls, 18% (377 records) appeared in the damage database. Pertinent damage information for these 377 records has therefore been made available DHS, including: OES Damage ID, Building and Safety Placard (tag), estimated damage, and estimated percent damage. See Table 2 for field definition and description.

2.0 MAP DEVELOPMENT

To depict the injury locations relative to indicators of hazard in the Northridge earthquake, ten (10) project maps were developed for DHS. EQE utilized the latitude and longitude previously associated with the Tax Assessor's database to locate injuries. In this manner, EQE obtained a latitude and longitude for virtually every record successfully matched to the Assessor's database; 59% (2,011 records) of the complete DHS injury database, and 69% of the earthquake-related injury records (449 records). In addition, DHS provided census tract data on Service Planning Areas (SPAs) that was used to create a map layer of SPA boundaries. These SPA boundaries are shown on each of the project maps.

Several of the project maps show the official Modified Mercalli Intensities (MMI) for the Northridge Earthquake, developed by the USGS (Dewey, 1995), overlain with the DHS Injury database. The DHS Injury data were also placed over contours of peak ground acceleration developed by Dr. David Wald of the United States Geological Survey (USGS). These contours were developed from accelerograph recordings compiled from a variety of sources, including the California Division of Mines and Geology (CDMG), Los Angeles Department of Water and Power (LADWP), Southern California Edison (SCE), the University of Southern California (USC) and the USGS.

EQE provided DHS with four (4) hard copy maps and one (1) overhead of each of the ten project maps on December 30, 1998. The final project maps include regional views as well as close-up views of two areas, the San Fernando area and Southwestern Los Angeles, as follows:

1. Injuries Recorded at Emergency Departments between 1/17 and 1/31 following the 1994 Northridge Earthquake (Mw 6.7) - Regional Extent

2. Injuries Recorded at Emergency Departments between 1/17 and 1/31 following the 1994 Northridge Earthquake (Mw 6.7) and Modified Mercalli Intensity - Regional Extent

3. Injuries Recorded at Emergency Departments between 1/17 and 1/31 following the 1994 Northridge Earthquake (Mw 6.7) and Modified Mercalli Intensity - San Fernando Extent

4. Injuries Recorded at Emergency Departments between 1/17 and 1/31 following the 1994 Northridge Earthquake (Mw 6.7) and Modified Mercalli Intensity - Southwestern Extent

5. Injuries Recorded at Emergency Departments between 1/17 and 1/31 following the 1994 Northridge Earthquake (Mw 6.7) and Peak Ground Acceleration Contours (%g) - Regional Extent

6. Injuries Recorded at Emergency Departments between 1/17 and 1/31 following the 1994 Northridge Earthquake (Mw 6.7) and Peak Ground Acceleration Contours (%g) - San Fernando Extent

7. Injuries Recorded at Emergency Departments between 1/17 and 1/31 following the 1994 Northridge Earthquake (Mw 6.7) and Peak Ground Acceleration Contours (%g) - Southwestern Extent

8. Injuries Recorded at Emergency Departments between 1/1/94 and 1/16/94 - Regional Extent

9. Injuries Recorded at Emergency Departments between 1/1/94 and 1/16/94 - San Fernando Extent

10. Injuries Recorded at Emergency Departments between 1/1/94 and 1/16/94 - Southwestern Extent

3.0 INJURY MODEL COMPARISON

This final task involved a limited comparison of earthquake-related injuries from the Los Angeles County injury database, to EQE's regional casualty models used in EPEDAT (the Early Post-Earthquake Damage Assessment Tool software). EPEDAT was developed for the California Office of Emergency Services to estimate regional earthquake impacts, such as building damage and casualties, for emergency response and planning purposes. EPEDAT utilizes enhanced versions of two published casualty algorithms to estimate a range of casualties expected on a regional basis.

3.1 EPEDAT Casualty Models

Most published casualty algorithms are simplified relationships between injury rates and building damage states (i.e., the ATC-13 injury model suggests a minor injury rate of 3 per 1,000 occupants, or .003, for buildings within the moderate damage state, defined as 10 - 30% damage). The first algorithm used in EPEDAT was taken from ATC-13 (1985), while the second was taken from Whitman (1974). Both of these methodologies estimate injury and death rates from building damage category, although it should be noted that the two

algorithms define the range of damage in each state differently. While these casualty estimates are mean death and injury rates for any building within a given damage state, each damage state includes a considerable range of possible damages. To adequately reflect the range of possible injuries within a given damage state, and the likely increase in casualties toward the upper end of the range, a probability distribution utilizing the mean casualty rate was applied to each individual building damage algorithm considered within EPEDAT. The beta probability distribution was selected, because these distributions were examined in ATC-13 and shown to be superior for approaching the problem of modeling uncertainty in earthquake damage. The resulting beta-modified algorithms relate injury and death rates to predicted damage for a given building type, at various levels of Modified Mercalli Intensity.

3.2 Selection of Injury Data for Model Comparison

The purpose of this task was to compare, to the extent possible, recorded injury data to regional injury models. It should be noted that the injury models are based on injury rates, estimating the number of people injured relative to the population exposed. Accordingly, implementation of the comparison would require an estimate of the exposed population. It was necessary, then, to work within an area where we could estimate both the total population exposed, as well as be reasonably sure we had captured all earthquake-related injuries.

EQE develops and maintains a variety of detailed building inventory data files for use in EPEDAT applications. Because population data is also required for casualty modeling, an area with detailed building inventory tabulated by census tract was required. For the current comparison, a recently developed database for the City of Los Angeles was utilized as the starting point for the building and population exposure estimates. This database was assembled from 1994 Los Angeles County Assessor's data, aggregated into EPEDAT building classes by census tract.

Because of the database limitation (i.e., must be within the City of Los Angeles), injuries presented at Hospital B could not be analyzed as it is beyond city limits. Maps of injury concentration for the remaining hospitals (A, C and D) were reviewed to identify a reasonable study area. As the data from Hospital A are considered incomplete, Hospitals C and D were used to identify the study area. To ensure a reasonable comparison of model injury rates to actual injury rates, it is important to analyze areas where we have confidence in both the estimate of the exposed population, and that the total number of documented injuries includes all earthquake-related injuries.

Based, in part, on the review of the map of injury concentration, we have limited the analysis to census tracts within 5 miles of Hospital C or D, and are therefore assuming that all injuries occurring within 5 miles of Hospital C or D were treated at one of the hospitals. That is, we have assumed that the current injury database represents the "universe" of injuries in all census tracts within 5 miles of Hospitals C and D. While this assumption is required to continue the analysis, it has a number of limitations. First, a significant number of injury records were not successfully matched to the Assessor's database, and therefore will not appear on the maps and will be omitted from this

comparison. Second, the injury database is limited to injuries recorded at the emergency departments of just four hospitals. Injuries treated at other hospitals, clinics, or First Aid stations, will not be included. Therefore, it is likely that the "universe" of injuries actually underestimates the total number of injuries.

As injury models vary by structural type, a common structural type with a significant population exposure and number of associated injuries was selected; wood frame, single family dwellings. The final analysis subset of injury data may be described as follows:

1. Injuries occurred in the post-earthquake time period (e.g., Timepd = 2)

2. Only earthquake-related injuries are included (e.g., Earthquake = 1 (clearly earthquake-related), Earthquake = 5 (assumed earthquake-related), and Earthquake = 9 (indirectly earthquake-related))

3. The injury record must have been successfully matched to the Assessor's database, and the parcel record must also have been associated with a census tract location.

4. The centroid of the census tract must be within 5 miles of either Hospital C or D, and be within the City of Los Angeles. (A total of 49 candidate census tracts were identified).

5. Only injuries occurring in single family, low-rise wood frame dwellings were included (e.g., Use Code = 0101 or 0100, single family dwelling, and Structure Type = D, Wood Frame.)

The resulting subset of injuries included 72 of the 459 earthquake-related injuries that were successfully matched to the Assessor's database (out of 650 total). These may be further classified by structure age, as considered by EPEDAT; pre-1950, and 1950 and later. Most of the injuries in the subset occurred in pre-1950 dwellings, reflecting the predominant age of residential construction in the southwestern Los Angeles study area. Table 3 provides a breakdown of the analyzed injury data according to earthquake hazard (Modified Mercalli Intensity) and injury severity.

Table 3 - Injury Data Included in Model Comparison

	Injury Severity										
	Mild		Moderate		Serious		Unknown		Total		
MMI	Pre-1950	1950+	Pre-1950	1950+	Pre-1950	1950+	Pre-1950	1950+	Pre-1950	1950+	TOTAL
VI	7	2	2	0	0	0	1	0	10	2	12
VII	20	6	5	1	1	0	2	0	28	7	35
VIII	23	0	2	0	0	0	0	0	25	0	25
Total	50	8	9	1	1	0	3	0	63	9	72

3.3 Determination of Exposed Population

While census data provides information on the total population residing within a given census tract, implementation of the injury models requires segregation of this data into a variety of structures and structure types. That is, the total number of occupants will be divided among residents of single family dwellings, apartment buildings, and condominiums.

For the purpose of the current comparison, occupant loading as determined within the EPEDAT database has been utilized. EPEDAT allocates residential occupants through a combination of census data and published occupancy algorithms. ATC-13 (1985) provides a generic occupancy algorithm that indicates that permanent residential dwellings will have a typical nighttime occupancy of 3.1 persons per thousand square feet. However, this does not consider variations in population density. That is, one would expect more occupants per thousand square foot in an inner-city area of multi-family apartments (e.g., East Los Angeles), than in a more suburban neighborhood dominated by larger single family homes (e.g., Beverly Hills). To take these variations into account, EPEDAT utilizes normalization factors that scale the estimated number of occupants to the actual number reported by the census data. For a given census tract, the total number of residential square feet is used to predict a preliminary occupancy from the ATC-13 model. This number is then scaled up to match the census data, and the resulting multiplier used to adjust estimates for individual classes of buildings within the tract. While there may be some error associated with these assumptions, it reflects an improvement over the unmodified occupancy algorithm.

For each of the 49 census tracts whose centroids fell within 5 miles of either Hospital C or D, the number and total square footage of wood frame, low-rise single family dwellings was determined. These square footage estimates were used with the census tract normalization factors to estimate the total number of occupants within the selected class of structure. Because of limitations associated with the normalization factors, five census tracts were removed from the data set. The final resulting data set included 8 census tracts at MMI VI, 21 census tracts at MMI VII, and 15 census tracts at MMI VIII.

It is interesting to note that the 1990 census data indicates that there are 192,796 people living within the 44 remaining census tracts. Using the EPEDAT algorithm, 143, 668 (75%) are assumed to reside within single family wood frame structures. The remainder will be distributed among multi-family apartment buildings, condominiums, single family dwellings of other construction types, and other residential structures. Of the 143,668 residents of single family wood frame structures, approximately 115,000 (80%) live in pre-1950 structures, while the remaining 20% live in newer (1950 and later) homes.

3.4 Comparison of Injury Models to Northridge Injury Data

The population exposure data, and associated injuries are summarized in Table 4. As can be seen in the table, most (77%) of the exposed dwellings were constructed prior to 1950, and are typically smaller than the newer structures. In addition, most of the identified injuries occurred in these older structures. A cursory review of injury rates indicates that

the older structures exhibit higher average injury rates than the newer structures, with injury risk generally increasing with Modified Mercalli Intensity. It should be noted that the lack of injury data for modern (1950 and later) wood frame dwellings at MMI VIII indicates that the current sample is too small to adequately capture potential injuries.

Table 4 Summary of Population Exposure Data for Single Family Wood Frame Dwellings in 44 Selected Census Tracts

Structure Age	MMI (# CTs)	Number of Buildings	Building Area (SF)	Average Area (SF)	EPEDAT Estimated Population	Number of DHS Injuries	Average DHS Injury Rate
Pre-1950	VI (8)	5,278	7,216,146	1,367	19,913	9	4.5×10^{-4}
Pre-1950	VII (21)	14,059	25,762,078	1,832	50,013	23	4.6×10^{-4}
Pre-1950	VIII (15)	8,998	13,233,366	1,470	45,165	25	5.5×10^{-4}
Total: Pre-1950		28,335	46,211,590	1,630	115,091	57	
1950 and later	VI (8)	3,150	6,170,694	1,959	11,998	2	1.7×10^{-4}
1950 and later	VII (21)	4,605	12,100,261	2,628	13,071	4	3.1×10^{-4}
1950 and later	VIII (15)	722	1,190,642	1,649	3,508	0	0
Total: 1950 and Later		8,477	19,461,597	2,296	28,577	6	
Overall Total		36,812	65,673,187	1,784	143,668	63	

For comparison, injury rates for individual census tracts may be plotted relative to the injury models currently utilized within EPEDAT. Figure 1 presents the individual census tract injury rates for pre-1950 single family wood frame dwellings, relative to both EPEDAT injury models. Each open square symbol on the chart represents the injury rate computed for a single census tract. The figure shows that the injury rates estimated from the current Northridge earthquake subset fall well below the upper bound EPEDAT model (EPEDAT/Whitman), and are distributed more closely around the EPEDAT/ATC model. Figure 2 provides a similar chart for post-1950 construction. Again, the computed Northridge injury rates fall well below the EPEDAT/Whitman, and relate more closely to the EPEDAT/ATC curve. It should be kept in mind that it is anticipated that the current data set underestimates the actual number of injuries, and hence will underestimate the resultant injury rate.

When sufficient data exists, it is also possible to examine the distribution of injury rates for a given structure type at various intensity levels. Figures 3 and 4 present the distribution of injury rates for pre-1950 dwellings, and dwellings constructed in 1950 and later, respectively. Also shown on the figures are the number of data points (n), the resulting mean injury rates, and the estimated standard deviation. Although the overall number of data points may be too small to draw definite conclusions, the figures can be

used to identify general trends. As shown on Figures 3 and 4, there is no demonstrated difference between the mean injury rates for wood frame dwellings in MMI VI and VII, although pre-1950 dwellings do show an increase in mean injury rate between MMI VII and VIII. However, the standard deviation increases consistently with MMI (recognizing the limitations of the database under consideration), indicating an increasingly wider dispersion of injury rates with increasing MMI. The limitations of the data are more obvious on Figure 4, which demonstrates that all injury rates for MMI VIII are zero.

The mean injury rates for a given MMI may be compared to the lower bound EPEDAT/ATC model rates, as shown in Table 5. For pre-1950 wood frame dwellings, the Northridge earthquake injury rate is larger than the model rate at MMI VI and VII, and smaller than the model rate at MMI VIII. However, if one examines the range defined by the computed "mean plus one sigma" and the "mean minus one sigma" injury rates, the model rates are mostly within these bounds, or of the same order of magnitude as the bounding values. For example, at MMI VIII, the Northridge earthquake mean injury rate plus one standard deviation is roughly of the same order of magnitude as the model rate (0.00131 vs. 0.00196).

TABLE 5 COMPARISON OF NORTHRIDGE EARTHQUAKE MEAN INJURY RATES WITH EPEDAT/ATC INJURY MODEL FOR PRE-1950 WOOD FRAME DWELLINGS

Building Age	MMI	Sample Size (n)	Northridge Mean Injury Rate	Northridge Standard Deviation	Northridge mean minus one standard deviation	Northridge mean plus one standard deviation	EPEDAT-ATC Injury Rate
Pre-1950	VI	7	5.0×10^{-4}	3.5×10^{-4}	1.5×10^{-4}	8.5×10^{-4}	9.0×10^{-5}
Pre-1950	VII	21	5.0×10^{-4}	4.2×10^{-4}	8.0×10^{-5}	9.2×10^{-4}	2.8×10^{-4}
Pre-1950	VIII	15	7.0×10^{-4}	6.1×10^{-4}	6.1×10^{-4}	1.31×10^{-3}	1.96×10^{-3}

Conclusions and Recommendations

There are many limitations associated with the current injury rate comparison, including:

- The injury data was limited to injuries recorded at the emergency departments of four hospitals, only two of which were used for the model comparison. Injuries not presented at emergency departments, such as injuries treated at clinics, or at first aid stations will be omitted. Further, only about 70% of injury records were successfully matched to the Assessor's database and were available for model comparison. Accordingly, it is expected that the resulting injury rates underestimate actual injury rates.

- The population exposure estimates are based on 1990 census data. The exposed population is distributed among various residential structure types by means of a generic occupancy algorithm identifying the number of people per thousand square feet of residential occupancy, scaled up or down to reflect the total census

tract exposure. While this is expected to be an improvement over the generic algorithm, it does not consider variations in density between single and multi-family structures within the same census tract.

- The limited number of data points (e.g., 44 census tracts) are not sufficient to draw definitive conclusions regarding the appropriateness of existing injury models for single family wood frame dwellings, and no other structure types are addressed under the current comparison.

Despite the limitations of the current assessment, it is clear that the current approach to validating and improving existing injury modeling techniques is appropriate. The Northridge earthquake was the first modern, urban earthquake in the U.S. for which both injury data and damage data were collected in a systematic way, and it provides an excellent opportunity for assessment and improvement of existing injury modeling techniques. Additional injury model review should be conducted, and would be greatly facilitated by

- the collection and review of additional injury data (from Northridge and other earthquakes)
- examination of additional parameters (injury severity, building damage and loss, building inspection tag, other ground motion parameters)
- development of additional building and population exposure databases for areas where Northridge injury data already exists (e.g., Hospital B)
- extension of the model comparison to other abundant structure types, such as multi-family structures and apartments.
- development of guidelines for post-earthquake collection of injury and building damage data to facilitate future analyses and model improvements

We have appreciated the opportunity to work with you on this important research topic, and look forward to additional collaboration in the future. Please feel free to call should you have any questions.

Sincerely,
EQE INTERNATIONAL, INC.

Hope A. Seligson
Principal Engineer

cc: Ronald T. Eguchi, EQE International

Attachments:
Evernden Soil Code Definitions
Los Angeles County Assessor's Tax Roll Use Code Definitions

References:

ATC (1985), Earthquake Damage Evaluation Data for California, Applied Technology Council, ATC-13, Redwood City, California.

Dewey, J.W., B.G. Reagor, L. Dengler, and K. Moley (1995). "Intensity Distribution and Isoseismal Maps for the Northridge, California, Earthquake of January 17, 1994," U.S. Geological Survey Open-File Report 95-92.

Evernden, J.F. and J.M. Thomson, (1988), "Predictive Model for Important Ground Motion Parameters Associated with Large and Great Earthquakes," United States Geological Survey Bulletin 1838.

EQE International, Inc. and the Governor's Office of Emergency Services (1995). The Northridge Earthquake of January 17, 1994: Report of Data Collection and Analysis, Part A: Damage and Inventory Data, Irvine, California

Whitman, R.V., J.M. Biggs, J. Brennan III, C.A. Cornell, R. de Neufville, and E.H. Vanmarcke (1974), Methodology and Pilot Application - Seismic Design Decision Analysis, Massachusetts Institute of Technology Civil Engineering Report R74-15.

Figure 1 - Injury Model Comparison - Single Family Wood Frame Dwellings, Pre-1950

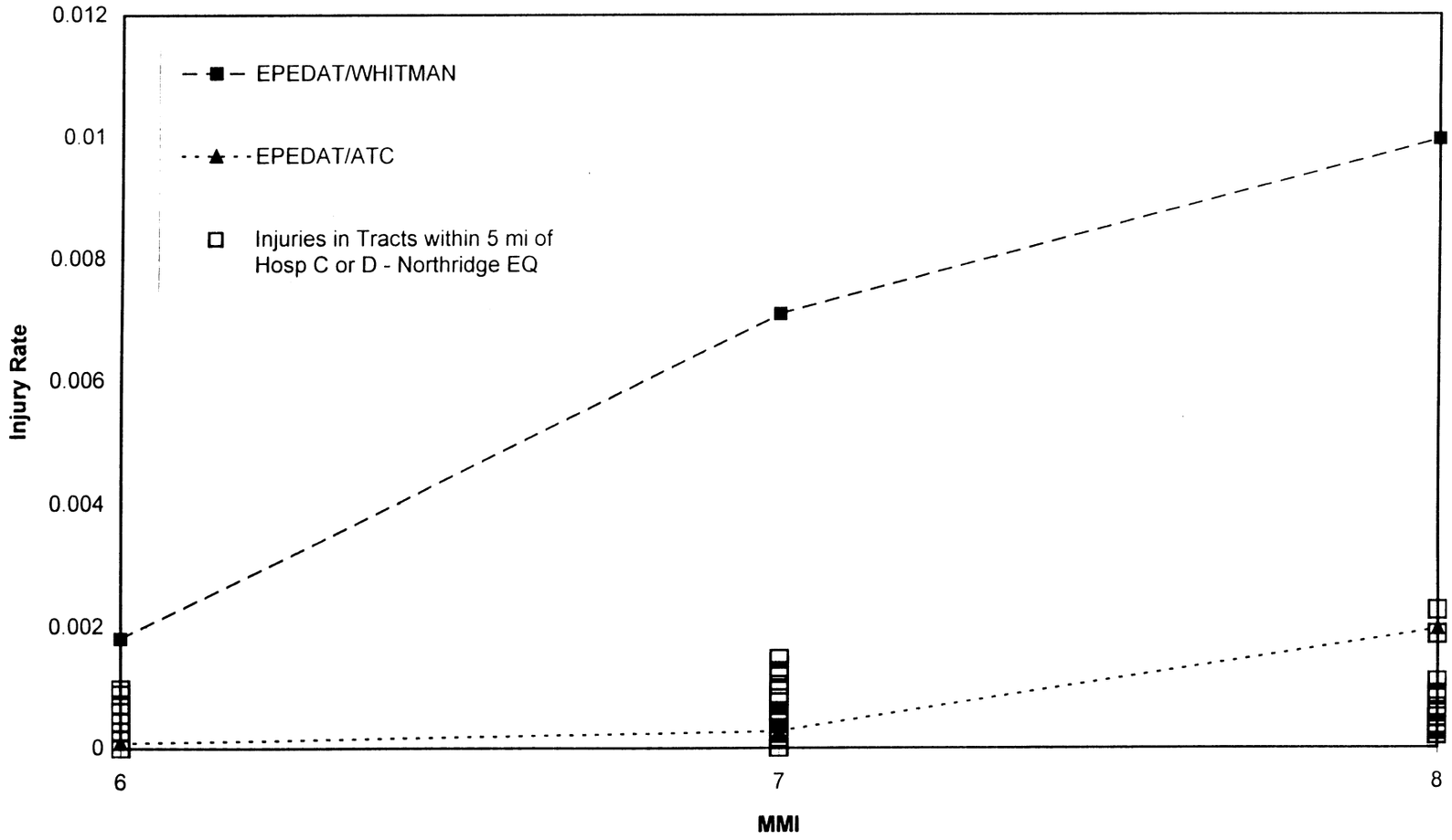


Figure 2 - Injury Model Comparison - Single Family Wood Frame Dwellings, 1950 and Later

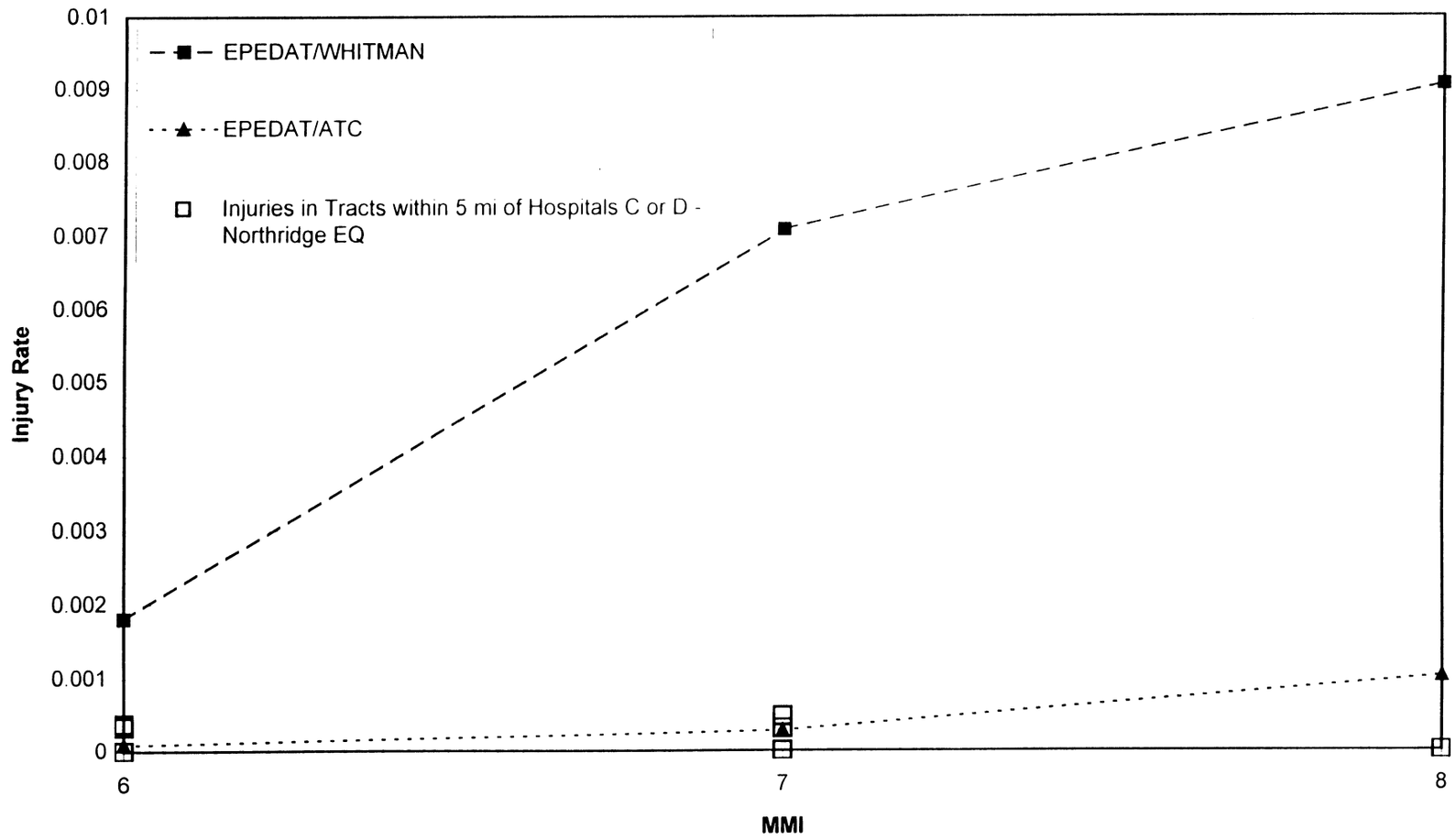


Figure 3 - Distribution of Injury Rates for Single Family Wood Frame Dwellings, Pre-1950

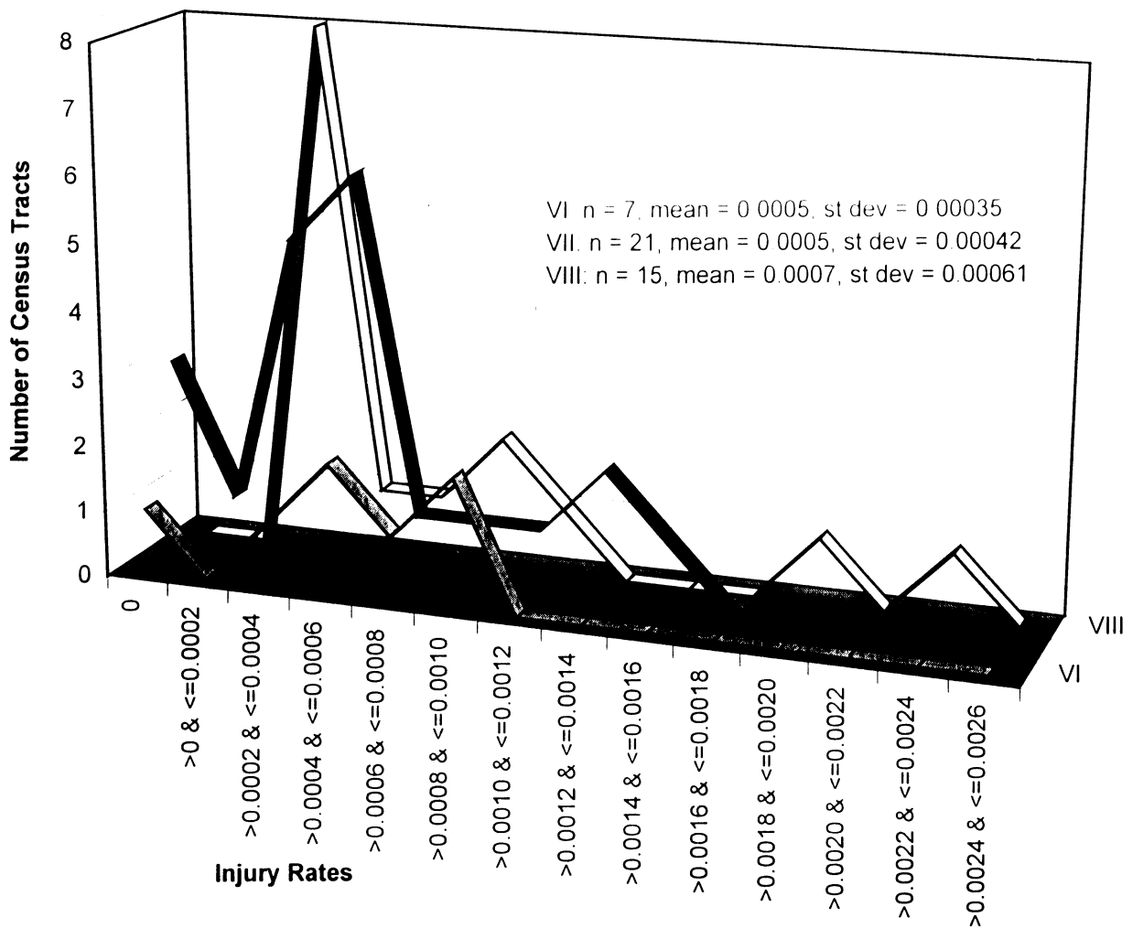
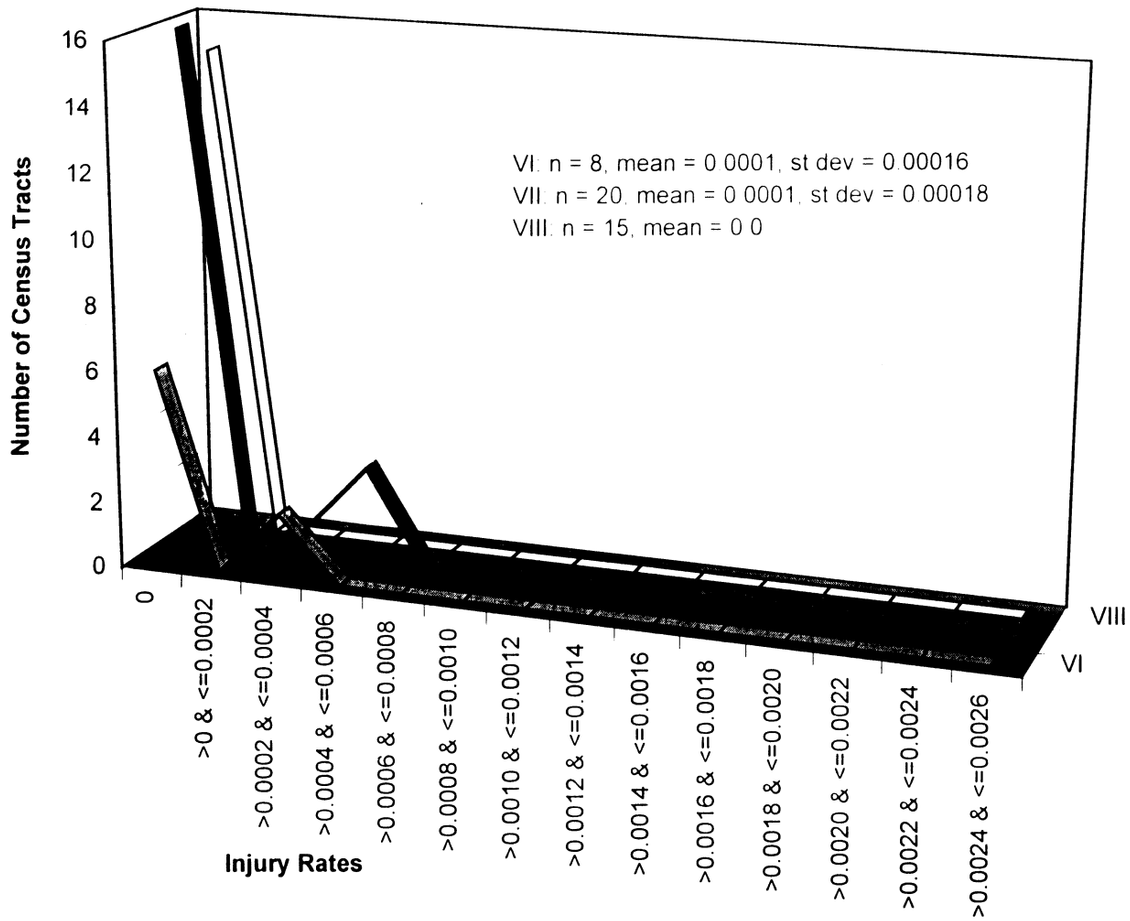


Figure 4 - Distribution of Injury Rates for Single Family Wood Frame Dwellings, 1950 and Later



Maya Mahue-Giangreco
2/16/99

Attachment I
Evernden Soil Code Definitions

Soil Code	Site Geology
A	Granitic and Metamorphic Rock
B	Paleozoic Sedimentary Rock
C	Early Mesozoic Sedimentary Rock
D	Cretaceous-Eocene Sedimentary Rock
E	Undivided Tertiary Sedimentary Rock
F	Oligocene-Pliocene Sedimentary Rock
G	Pliocene/Pleistocene Sedimentary Rock
H	Tertiary Volcanic Rock
I	Quaternary Volcanic Rock
J	Quaternary Sedimentary Deposits (Shallow Groundwater)
K,L,M	Other Quaternary Sedimentary Deposits

Maya Mahue-Giangreco
2/16/99

Attachment II

Los Angeles County Assessor's Tax Roll Use Code Definitions

PROPERTY USE CLASSIFICATION CHART

0000 RESIDENTIAL

00 (OPEN)

010V-VACANT LAND

01 SINGLE
3rd digit-0 4th digit
1=Pool
4=Therapy Pool
C=Condominium
D=Planned Res Development

02 DOUBLE, DUPLEX, OR TWO UNITS

03 THREE UNITS (ANY COMBINATION)

04 FOUR UNITS (ANY COMBINATION)

05 FIVE OR MORE APARTMENTS OR UNITS
3rd digit 4th digit
0=4 stories or less 1=Pool
5=5 stories or more A=Cooperative
B=Own-Your-Own

06 (OPEN)

07 (OPEN)

08 ROOMING HOUSES

09 MOBILE HOME PARKS
3rd digit-0 4th digit
1=Pool

1000 *COMMERCIAL

10 (OPEN)

100V VACANT LAND

1010 Misc'l Commercial

11 STORES

12 STORE COMBINATION (WITH OFFICE OR RESIDENTIAL)
3rd digit
0=Store & Office Combination
1=Store & Residential Combination

13 DEPARTMENT STORES
3rd digit
1=Discount Department Store
2=Building Supplies (Builders Emporiums, etc.)
3=Home Furnishings (Barker Brothers, etc.)
4=Retail-Warehouse Combination (Levitz)

14 SUPERMARKETS
3rd digit
0=Supermarket- 12000# or more
1=Supermarket- 6000# through 11999#
2=Small Food Stores- less than 6000#

15 SHOPPING CENTERS (NEIGHBORHOOD, COMMUNITY)

16 SHOPPING CENTERS (REGIONAL)

17 OFFICE BUILDINGS
3rd digit
1=Loft type Buildings
2=Office and Residential

18 HOTEL AND MOTELS
3rd digit
0=Hotels- under 50 rooms
1=Hotels- 50 rooms and over
2=Motels- under 50 units
3=Motels- 50 units and over
4=Motel/Hotel and Apartment Combinations- Under 50 units
5=Motel/Hotel and Apartment Combinations- 50 units and over

19 PROFESSIONAL BUILDINGS
3rd digit
1=Medical Dental Building
2=Veterinary Hospitals, Clinics

2000 *COMMERCIAL

20 (OPEN)

21 RESTAURANTS, COCKTAIL LOUNGES
3rd digit
0=Restaurants, Cocktail Lounges, Taverns
1=Fast Food- Walk Up
2=Fast Food- Auto Orientated

22 WHOLESALE AND MANUFACTURING OUTLETS

23 BANKS, SAVINGS & LOANS

24 SERVICE SHOPS
RADIO & T.V. REPAIR
REFRIGERATION SERVICE
PAINT SHOPS
ELECTRIC REPAIR
LAUNDRIES

25 SERVICE STATIONS
3rd digit
0=Full Service
1=Self Serve
2=Station with Car Wash

26 AUTO, RECREATION EQPT., CONSTRUCTION EQPT., SALES & SERVICE
3rd digit
0=Auto Service Shops (Body & Fender Commercial Garage)
1=Used Car Sales
2=New Car Sales and Service
3=Car Wash
4=Car Wash- Self Service Type
5=Recreation Equipment Sales & Service (Campers, Motor Homes, Boats)
6=Farm and Construction Equipment Sales & Service
7=AUTO SERVICE CENTERS (NO GASOLINE)

27 PARKING LOTS (COMMERCIAL USE PROPERTIES)
3rd digit
0=Lots- Patron or Employee
1=Lots- Commercial Parkin
2=Parking Structures- Patr or Employee
3=Parking Structures- Cor cial Parking

28 ANIMAL KENNELS

29 NURSERIES OR GREENHOUSES

*For improved properties, 4th digit describes the number of stories in the main structure (with the exception of lifts or condominiums).

0= one story
2 thru 5=to indicate the # of stories from 2 thru 5
6= to indicate 6 thru 13 stories
7= to indicate 14 thru 20 stories
8= to indicate 21 thru 30 stories
9= to indicate over 30 stories

PROPERTY USE CLASSIFICATION CHART

3000 *INDUSTRIAL	4000	6000 *RECREATIONAL
30 (OPEN)	40 (OPEN)	60 (OPEN)
300V VACANT LAND	4010 PRIVATE RURAL PUMPING PLANT	61 THEATRES 3rd digit 0=Movie- Indoor 1=Movie- Drive-In 2=Legitimate Theatre
3010 Misc'l Industrial	41 FRUITS & NUTS	
31 LIGHT MANUFACTURING SMALL EQUIPMENT MANUFACTURING SMALL MACHINE SHOPS INSTRUMENTS MANUFACTURING PRINTING PLANTS	42 VINEYARDS	62 (OPEN)
	43 VINE & BUSH FRUITS	63 BOWLING ALLEYS
32 HEAVY MANUFACTURING	44 TRUCK CROPS	64 CLUBS, LODGE HALLS, FRATERNAL ORGANIZATIONS
33 WAREHOUSING, DISTRIBUTION, STORAGE 3rd digit 0=Warehousing, Distribution under 10,000#	45 FIELD CROPS	65 ATHLETIC AND AMUSEMENT FACILITIES 3rd digit 0=Auditoriums, Stadiums, Amphitheatres 1=Amusement Facilities 2=Commercial Swimming Pools, Schools 3=Gymnasiums, Health Spas 4=Dance Halls 5=Tennis Courts, Clubs, Pro Shops
	46 PASTURE	
	47 DAIRIES	
	48 POULTRY, ETC.	
	49 FEED LOTS	
1=Warehousing, Distribution 10,000# through 24,999#	5000 DRY FARM	
2=Warehousing, Distribution 25,000# through 50,000#	50 (OPEN)	
3=Warehousing, Distribution over 50,000#	51 FRUITS & NUTS	
4=Public Storage (Bekins, Lyons)	52 VINEYARDS	
5=Public Storage- Mini Warehouse	53 FIELD CROPS	
34 FOOD PROCESSING PLANTS 3rd digit 0=Meat 1=Beverage 2=Other	54 PASTURE	66 GOLF COURSES 3rd digit 1=Non Profit 2=Three Par 3=Miniature
	55 TIMBER - PINE	
	56 TIMBER - FIR	
35 MOTION PICTURE, RADIO AND TELEVISION INDUSTRIES 3rd digit 0=Studios 1=Transmission Facilities 2=Microwave Relay Towers	57 TIMBER - REDWOOD	67 RACE TRACKS 3rd digit 1=Horse Stable- Private
	58 DESERT	
	59 WASTE	68 CAMPS 3rd digit 1=Trailer and Camper Parks (overnight)
36 LUMBER YARDS		
37 MINERAL PROCESSING 3rd digit 1=Cement, Rock & Gravel Plants 2=Petroleum Refineries, Chemical Plants		69 SKATING RINKS 3rd digit 0=Ice 1=Roller
38 PARKING LOTS (INDUSTRIAL USE PROPERTIES)		
39 OPEN STORAGE 3rd digit 1=Trucking Companies, Terminals 2=Contractor Storage Yards	*For improved properties, 4th digit describes the number of stories in the main structure (with the exception of lifts or condominiums). 0= one story 2 thru 5=to indicate the # of stories from 2 thru 5 6= to indicate 6 thru 13 stories 7= to indicate 14 thru 20 stories 8= to indicate 21 thru 30 stories 9= to indicate over 30 stories	

PROPERTY USE CLASSIFICATION CHART

7000 *INSTITUTIONAL	8800 GOVERNMENT OWNED PROPERTIES ("900" PARCELS)	
70 (OPEN)	8800 (OPEN)	
71 CHURCHES 3rd digit 1=Church Parking Lots	880V VACANT LAND 8810 Rights of Way, General 8811 Street, Road, Highway	
72 SCHOOLS (PRIVATE)	8812 Future Street, Alley, etc. 8813 Power Transmission Lines 8814 Sewers, Utilities	
73 COLLEGES, UNIVERSITIES (PRIVATE)	8820 Government Services, General 8821 City Hall, Administration Center 8822 Auxiliary and Regional Center 8823 Police and Fire Station 8824 Utilities Office (Power, Water, etc.) 8825 Welfare and Social Services 8826 Postal Facility 8827 Library 8828 Court Building, Jail 8829 Military Post	8857 Dam 8858 Reservoir, Tank Underground Storage 8859 Watershed
74 HOSPITALS 3rd digit 1=Convalescent Hospitals, Nursing Homes	8830 Public School, General 8831 College 8832 High School 8833 Elementary School 8834 School Administration Center 8835 School Service Center	8860 Transportation, General 8861 Harbor & Related 8862 Airport, General 8863 Airport, T Hanger 8864 Airport, Tie - Down 8865 Airport, Fixed - Base Operator 8866 Rapid Transit, Bus, etc.
75 HOMES FOR AGED & OTHERS	8840 Recreation, General 8841 Public Park 8842 Art Center, Museum 8843 Public Swimming Pool 8844 Sports Stadium 8845 Beach 8846 Horse Stable 8847 Amusement Ride 8848 Ball Field (Little League, etc.) 8849 Youth Facility (Scouts, etc.)	8870 Concession on Public Property 8871 Food Concession 8872 Souvenir Shop 8873 Parking Lot Lease 8874 Office Space Lease
76 (OPEN)	8850 Water Related Facilities, General 8851 Small Boat Marina 8852 Boat Slip 8853 Boat Mooring 8854 Pier, Wharf 8855 Flood Control Drainage 8856 Irrigation - Related	8890 Community Redevelopment 8891 Public Housing 8899 Government Property and Possessory Interest Not Classifiable in Any of Above
77 CEMETERIES, MAUSOLEUMS, MORTUARIES 3rd digit 0=Cemeteries, Mausoleums 1=Mortuaries, Funeral Homes		8900 DUMP SITES
78 (OPEN)		
79 (OPEN)		
* For improved properties, 4th digit describes the number of stories in the main structure (with exception of lifts or condominiums). See Section 4.3 B.		
8000 MISCELLANEOUS		
80 (OPEN)		
81 UTILITY COMMERCIAL & MUTUAL; PUMPING PLANTS; STATE ASSESSED PROPERTY		
82 MINING		
83 PETROLEUM & GAS		
84 PIPE LINES, CANALS		
85 RIGHTS OF WAY		
86 WATER RIGHTS		
87 RIVERS & LAKES		

*For improved properties, 4th digit describes the number of stories in the main structure (with the exception of lifts or condominiums).

0= one story

2 thru 5=to indicate the # of stories from 2 thru 5

6= to indicate 6 thru 13 stories

7= to indicate 14 thru 20 stories

8= to indicate 21 thru 30 stories

9= to indicate over 30 stories

APPENDIX 4

Table A-1. Pre-Earthquake Weekday Injury Visits Compared to Post-Earthquake Weekday Injury Visits Treated at 3 Hospitals in Los Angeles County, January 1994.

Facility	Weekday	Means (Std. Dev.) Pre-Event	Post-Event	p-value^
Hospital 'B'	Tuesday	15.5 (2.12)	29 (12.73)	n.s.*
	Wednesday	14 (1.41)	19 (14.14)	n.s.*
	Thursday	16 (7.07)	11.5 (3.54)	n.s.*
	Friday	23.5 (15.33)	16.5 (6.36)	n.s.*
	Saturday	29.33 (6.66)	16.5 (0.71)	$p < 0.05$ (decrease)
	Sunday	21.33 (2.08)	14 (4.24)	n.s.*
	Monday	13.67 (2.08)	11 (1.41)	n.s.*
Hospital 'C'	Tuesday	50 (4.24)	59.5 (13.43)	n.s.*
	Wednesday	42.5 (2.12)	49.5 (0.71)	n.s.*
	Thursday	36.5 (6.36)	54 (0)	n.s.*
	Friday	40.5 (4.95)	44 (7.07)	n.s.*
	Saturday	40.67 (5.51)	48 (2.83)	$p < 0.05$ (increase)
	Sunday	39.67 (7.77)	32 (9.90)	n.s.*
	Monday	49 (3)	55 (0)	n.s.*
Hospital 'D'	Tuesday	19.5 (3.54)	29 (4.24)	n.s.*
	Wednesday	18.5 (9.19)	25.5 (10.61)	n.s.*
	Thursday	16.5 (7.78)	23 (2.83)	n.s.*
	Friday	26.5 (3.54)	25 (4.24)	n.s.*
	Saturday	23 (1)	26 (0)	$p < 0.05$ (increase)
	Sunday	22 (7)	34.5 (3.54)	n.s.*
	Monday	17 (5.29)	21 (0)	n.s.*

^ From modified 2-sample t-test (assumes unequal variances):

$$t=(\bar{x}_1-\bar{x}_2)/(\sqrt{((s^2_1/n_1)+(s^2_2/n_2))})$$

$$df=v$$

$$v=((s^2_1/n_1)+(s^2_2/n_2))/[((s^2_1/n_1)^2/(n_1-1))+((s^2_2/n_2)^2/(n_2-1))]$$

* not statistically significant, $p > 0.05$

Table A-2. Differences between Frequencies of Injuries Treated at 3 Emergency Departments in Los Angeles County: 1 Week Post-Northridge Earthquake Compared to Weekday Averages for the Rest for January, 1994.

Hospital	Weekday	Date	Frequency	Comparison Average	p-value^
Hospital 'B'	Tues.	1/18/94	38	17.0	< 0.05
	Wed.	1/19/94	29	12.3	< 0.05
	Thurs.	1/20/94	9	15.3	n.s.*
	Fri.	1/21/94	12	22.7	< 0.05
	Sat.	1/22/94	16	26.3	< 0.05
	Sun.	1/23/94	17	18.8	n.s.*
	Mon.	1/24/94	12	13.0	n.s.*
Hospital 'C'	Tues.	1/18/94	69	50.0	< 0.05
	Wed.	1/19/94	50	44.7	n.s.*
	Thurs.	1/20/94	54	42.3	n.s.*
	Fri.	1/21/94	39	43.3	n.s.*
	Sat.	1/22/94	50	42.0	< 0.05
	Sun.	1/23/94	39	36.0	n.s.*
	Mon.	1/24/94	52	50.0	n.s.*
Hospital 'D'	Tues.	1/18/94	32	21.7	< 0.05
	Wed.	1/19/94	33	18.3	< 0.05
	Thurs.	1/20/94	25	18.0	n.s.*
	Fri.	1/21/94	28	25.0	n.s.*
	Sat.	1/22/94	26	23.8	< 0.05
	Sun.	1/23/94	32	23.3	n.s.*
	Mon.	1/24/94	19	17.7	n.s.*

^ 1-sample t-test: $t=(\bar{x}-\mu) / (s/(\sqrt{n}))$

* Not statistically significant, $p > 0.05$

Table A-3. Mechanisms of Injuries for 3 Emergency Departments: 1/17/94 Versus Average from Other Mondays, January 1994.

Mechanism	Hospital	Frequency	Comparison Group Average	Comparison Group Std Dev	t-test*	d.f.	p < 0.05**
Motor Vehicle Collisions	'B'	10	2.50	0.58	-25.98	3	increase
	'C'	1	6.75	3.50	3.29	3	decrease
	'D'	0	1.00	0.00	undefined	---	---
Firearm and violent injuries	'B'	0	0.00	---	---	---	---
	'C'	0	1.25	0.50	5.00	3	decrease
	'D'	2	1.25	1.50	-1.00	3	n.s.
Falls	'B'	33	3.25	0.50	-119.00	3	increase
	'C'	15	12.50	2.38	-2.10	3	n.s.
	'D'	30	5.75	2.22	-21.87	3	increase
Poisonings	'B'	6	1.00	0.82	-12.25	3	increase
	'C'	1	2.50	2.65	1.13	3	decrease
	'D'	2	3.00	1.15	1.73	3	decrease
Cut by or pierced by	'B'	60	1.50	0.58	-202.65	3	increase
	'C'	26	8.00	3.37	-10.69	3	increase
	'D'	20	2.75	1.48	-23.26	3	increase
Struck by or against	'B'	54	1.75	1.26	-83.05	3	increase
	'C'	23	5.25	2.63	-13.50	3	increase
	'D'	18	2.50	2.38	-13.02	3	increase
Caught in or between object(s)	'B'	0	0.25	0.50	1.00	3	decrease
	'C'	0	1.00	0.82	2.45	3	decrease
	'D'	3	0.50	0.58	-8.66	3	increase
Fire or burn	'B'	1	0.00	0.00	---	---	---
	'C'	0	1.50	0.58	5.20	3	decrease
	'D'	1	0.00	---	---	---	---
Overexertion	'B'	1	0.75	0.96	-0.52	3	n.s.
	'C'	1	1.75	1.26	1.19	3	decrease
	'D'	3	0.25	0.50	-11.00	3	increase
Other mechanisms	'B'	3	0.75	0.50	-9.00	3	increase
	'C'	2	7.00	1.26	7.95	3	decrease
	'D'	8	1.00	0.82	-17.15	3	increase
Unknown mechanisms	'B'	39	1.00	1.15	-65.82	3	increase
	'C'	7	3.00	1.63	-4.90	3	increase
	'D'	9	---	---	---	---	---

* $t=(\bar{x}-\mu)/(s/(\sqrt{n}))$

** 3 degrees of freedom, 1-tailed critical value: -2.353

Table A-4. Mechanisms of Injuries for 3 Emergency Departments: 1/18/94 Versus Average from Other Tuesdays, January 1994.

Mechanism	Hospital	Frequency	Comparison Group Average	Comparison Group Std Dev	t-test*	p < 0.05**
Motor Vehicle Collisions	'B'	3	5.33	3.06	1.32	decrease
	'C'	2	5.67	3.06	2.08	decrease
	'D'	3	3.67	2.08	0.55	decrease
Firearm and violent injuries	'B'	1	0.33	0.58	-2.00	n.s.
	'C'	0	2.33	1.15	3.50	decrease
	'D'	0	1.33	1.53	1.51	decrease
Falls	'B'	6	3.33	2.08	-2.22	n.s.
	'C'	14	10.67	0.58	-10.00	increase
	'D'	15	3.67	1.53	-12.85	increase
Poisonings	'B'	1	2.67	0.58	5.00	decrease
	'C'	3	2.33	1.15	-1.00	n.s.
	'D'	2	1.33	1.53	-0.76	n.s.
Cut by or pierced by	'B'	8	2.67	1.15	-8.00	increase
	'C'	16	6.33	1.53	-10.96	increase
	'D'	4	3.67	2.89	-0.20	n.s.
Struck by or against	'B'	13	1.00	0.00	----	increase
	'C'	15	8.33	1.53	-7.56	increase
	'D'	3	2.67	2.08	-0.28	n.s.
Caught in or between object(s)	'B'	0	0.00	----	----	---
	'C'	0	1.67	2.08	1.39	decrease
	'D'	1	0.33	0.58	-2.00	n.s.
Fire or burn	'B'	1	0.00	----	----	---
	'C'	2	1.33	1.53	-0.76	n.s.
	'D'	0	0.67	1.15	1.00	decrease
Overexertion	'B'	0	0.33	0.58	1.00	decrease
	'C'	1	1.33	0.58	1.00	decrease
	'D'	0	1.33	1.53	1.51	decrease
Other mechanisms	'B'	4	0.67	0.58	-10.00	increase
	'C'	3	8.00	4.36	1.99	decrease
	'D'	3	1.67	0.58	-4.00	increase
Unknown mechanisms	'B'	1	0.67	0.58	-1.00	n.s.
	'C'	13	2.00	1.00	-19.05	increase
	'D'	1	1.33	1.15	0.50	decrease

* $t=(\bar{x}-\mu)/(s/(\sqrt{n}))$

** 2 degrees of freedom, 1-tailed critical value: -2.92

Table A-5. Mechanisms of Injuries for 3 Emergency Departments: 1/19/94 Versus Average from Other Wednesdays, January 1994.

Mechanism	Hospital	1/19/94 Frequency	Comparison Group Average	Comparison Group Std Dev	t-test*	p < 0.05**
Motor Vehicle Collisions	'A'	6	1.67	1.15	-6.50	increase
	'D'	4	2.67	1.53	-1.51	n.s.
Firearm and violent injuries	'A'	0	0.00	0.00	---	---
	'D'	0	0.33	0.58	1.00	n.s.
Falls	'A'	7	2.67	2.08	-3.61	increase
	'D'	9	4.33	2.08	-3.88	increase
Poisonings	'A'	1	1.67	0.58	2.00	n.s.
	'D'	2	0.67	1.15	-2.00	n.s.
Cut by or pierced by	'A'	4	2.00	1.00	-3.46	increase
	'D'	6	3.33	2.52	-1.84	n.s.
Struck by or against	'A'	7	1.67	2.08	-4.44	increase
	'D'	4	1.33	0.58	-8.00	increase
Caught in or between object(s)	'A'	0	0.00	0.00	---	---
	'D'	0	0.33	0.58	1.00	n.s.
Fire or burn	'A'	1	0.00	0.00	---	---
	'D'	0	0.00	0.00	---	---
Overexertion	'A'	1	0.33	0.58	-2.00	n.s.
	'D'	1	1.00	1.00	0.00	n.s.
Other mechanisms	'A'	1	1.67	1.15	1.00	n.s.
	'D'	4	3.67	1.53	-0.38	n.s.
Unknown mechanisms	'A'	1	0.67	0.58	-1.00	n.s.
	'D'	3	0.67	0.58	-7.00	increase

* $t=(\bar{x}-\mu)/(s/(\sqrt{n}))$

** 2 degrees of freedom, 1-tailed critical value: -2.92

Table A-6. Mechanisms of Injuries for 3 Emergency Departments: 1/21/94 Versus Average from Other Fridays, January 1994.

Mechanism	Hospital	1/21/94 Frequency	Comparison Group Average	Comparison Group Std Dev	t-test*	p < 0.05**
Motor Vehicle Collisions	'A'	1	5.67	3.51	2.30	n.s.
Firearm and violent injuries	'A'	0	0.67	0.58	2.00	n.s.
Falls	'A'	6	5.00	1.73	-1.00	n.s.
Poisonings	'A'	1	1.67	0.58	2.00	n.s.
Cut by or pierced by	'A'	1	2.00	1.00	1.73	n.s.
Struck by or against	'A'	1	3.00	1.73	2.00	n.s.
Caught in or between object(s)	'A'	0	1.00	0.00	—	—
Fire or burn	'A'	0	0.33	0.58	1.00	n.s.
Overexertion	'A'	0	1.00	1.73	1.00	n.s.
Other mechanisms	'A'	2	1.00	1.73	-1.00	n.s.
Unknown mechanisms	'A'	0	0.33	0.58	1.00	n.s.

* $t=(\bar{x}-\mu)/(s/(\sqrt{n}))$

** 2 degrees of freedom, 1-tailed critical value: -2.92

Table A-7. Mechanisms of Injuries for 3 Emergency Departments: 1/22/94 Versus Average from Other Saturdays, January 1994.

Mechanism	Hospital	1/22/94 Frequency	Comparison Group Average	Comparison Group Std Dev	t-test*	p < 0.05**
Motor Vehicle Collisions	'B'	1	4.25	0.96	5.88	increase
	'C'	2	5.25	2.63	2.14	n.s.
	'D'	2	4.25	2.08	1.87	n.s.
Firearm and violent injuries	'B'	0	0.50	0.58	1.50	n.s.
	'C'	5	0.50	0.58	-13.50	increase
	'D'	1	1.00	1.53	0.00	n.s.
Falls	'B'	4	8.75	2.75	2.99	decrease
	'C'	18	12.00	1.41	-7.35	increase
	'D'	5	7.00	1.53	2.27	n.s.
Poisonings	'B'	0	1.75	1.71	1.77	n.s.
	'C'	2	2.50	1.29	0.67	n.s.
	'D'	1	2.75	1.53	1.98	n.s.
Cut by or pierced by	'B'	4	2.50	1.73	-1.50	n.s.
	'C'	3	7.75	3.50	2.35	n.s.
	'D'	6	1.75	2.89	-2.55	increase
Struck by or against	'B'	3	3.25	2.50	0.17	n.s.
	'C'	12	6.50	2.65	-3.60	increase
	'D'	7	2.75	2.08	-3.54	increase
Caught in or between object(s)	'B'	1	0.50	1.00	-0.87	n.s.
	'C'	1	1.75	0.50	2.60	decrease
	'D'	0	0.50	0.58	1.50	n.s.
Fire or burn	'B'	1	1.00	1.15	0.00	n.s.
	'C'	1	0.50	0.58	-1.50	n.s.
	'D'	0	0.25	1.15	0.38	n.s.
Overexertion	'B'	0	0.50	0.58	1.50	n.s.
	'C'	1	0.75	0.50	-0.87	n.s.
	'D'	0	0.25	1.53	0.28	n.s.
Other mechanisms	'B'	1	1.75	0.50	2.60	decrease
	'C'	5	1.75	1.26	-4.47	increase
	'D'	3	2.75	0.58	-0.75	n.s.
Unknown mechanisms	'B'	1	1.50	1.73	0.50	n.s.
	'C'	0	2.75	1.71	2.79	decrease
	'D'	1	0.50	1.15	-0.75	n.s.

* $t=(\bar{x}-\mu)/(s/(\sqrt{n}))$

** 3 degrees of freedom, 1-tailed critical value: -2.353

APPENDIX 5

Figure A-1. Map Presenting Injuries Recorded at Emergency Departments between 1/17/94 and 1/31/94 following the 1994 Northridge Earthquake, Regional Extent, Los Angeles County.

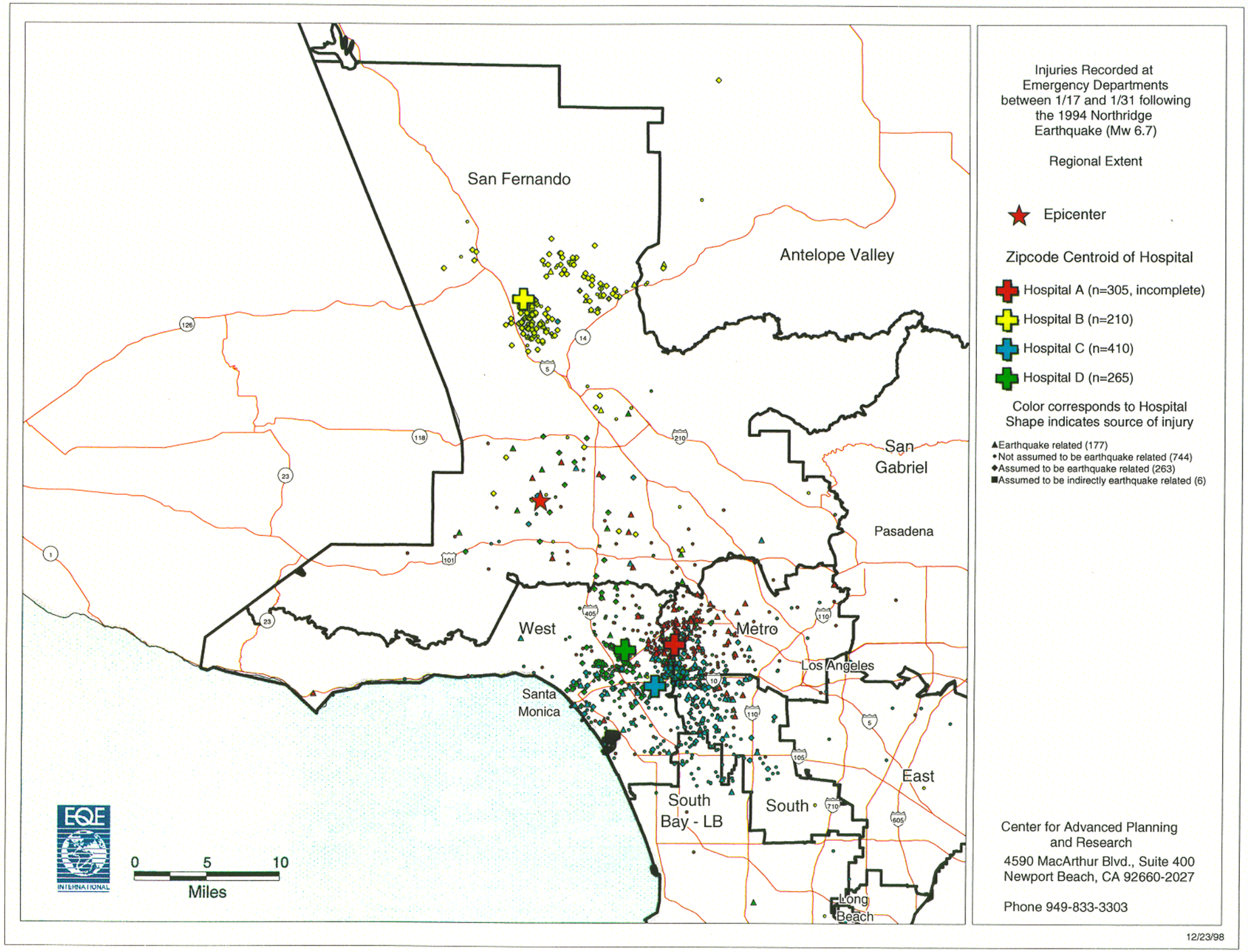

San Fernando
Antelope Valley
San Gabriel
Pasadena
West
Metro
Los Angeles
Santa Monica
South Bay - LB
South
East
Long Beach
0 5 10
Miles
Injuries Recorded at Emergency Departments between 1/17 and 1/31 following the 1994 Northridge Earthquake (Mw 6.7)
Regional Extent
Epicenter
Zipcode Centroid of Hospital
Hospital A (n=305, incomplete)
Hospital B (n=210)
Hospital C (n=410)
Hospital D (n=265)
Color corresponds to Hospital
Shape indicates source of injury
▲Earthquake related (177)
•Not assumed to be earthquake related (744)
◆Assumed to be earthquake related (263)
■Assumed to be indirectly earthquake related (6)
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Figure A-2. Map Presenting Injuries Recorded at Emergency Departments between 1/1/94 and 1/16/94, Regional Extent, Los Angeles County.

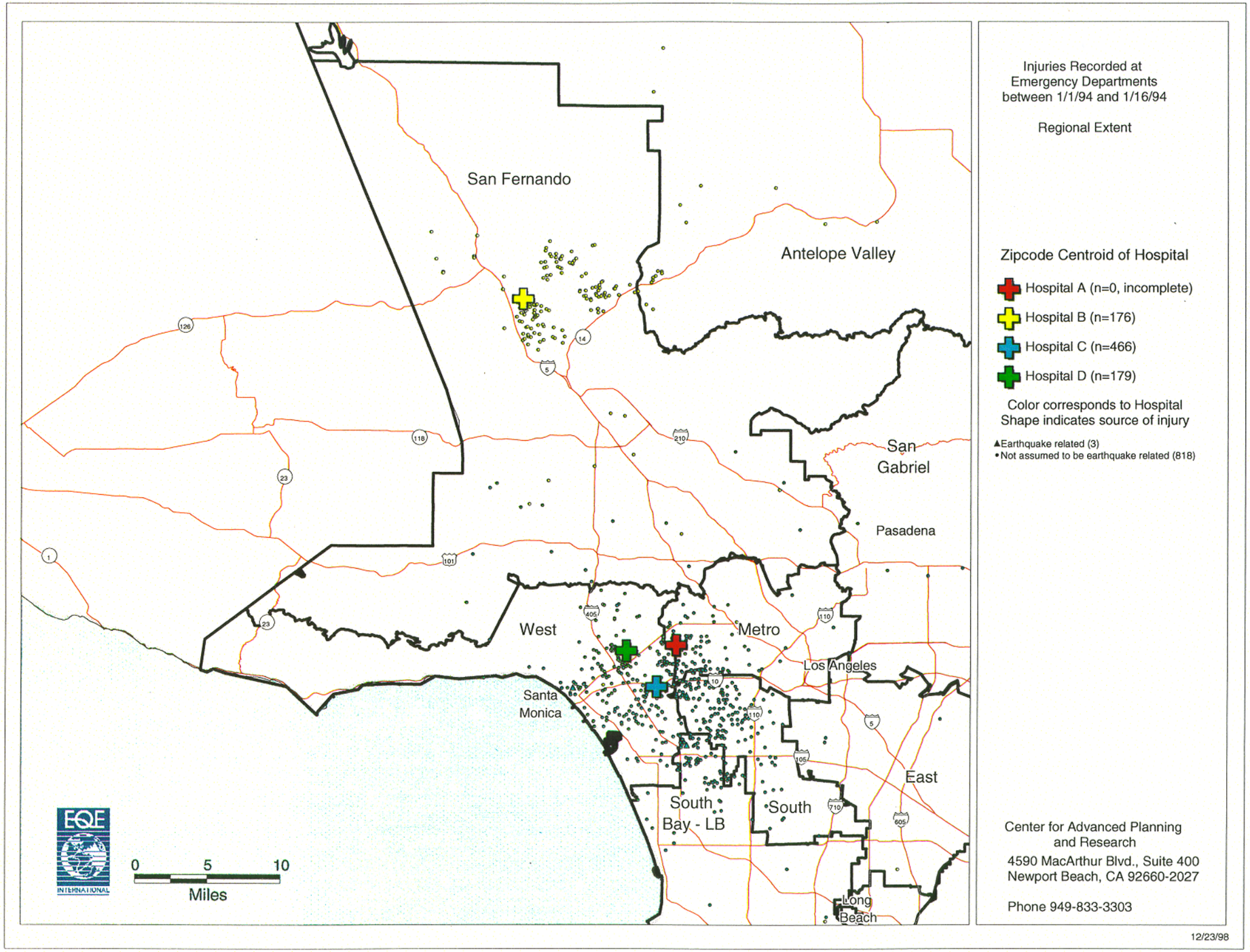
San Fernando
Antelope Valley
San Gabriel
Pasadena
West
Metro
Los Angeles
Santa Monica
South Bay - LB
South
East
Long Beach
0 5 10
Miles
Injuries Recorded at Emergency Departments between 1/1/94 and 1/16/94
Regional Extent
Zipcode Centroid of Hospital
Hospital A (n=0, incomplete)
Hospital B (n=176)
Hospital C (n=466)
Hospital D (n=179)
Color corresponds to Hospital
Shape indicates source of injury
▲Earthquake related (3)
•Not assumed to be earthquake related (818)
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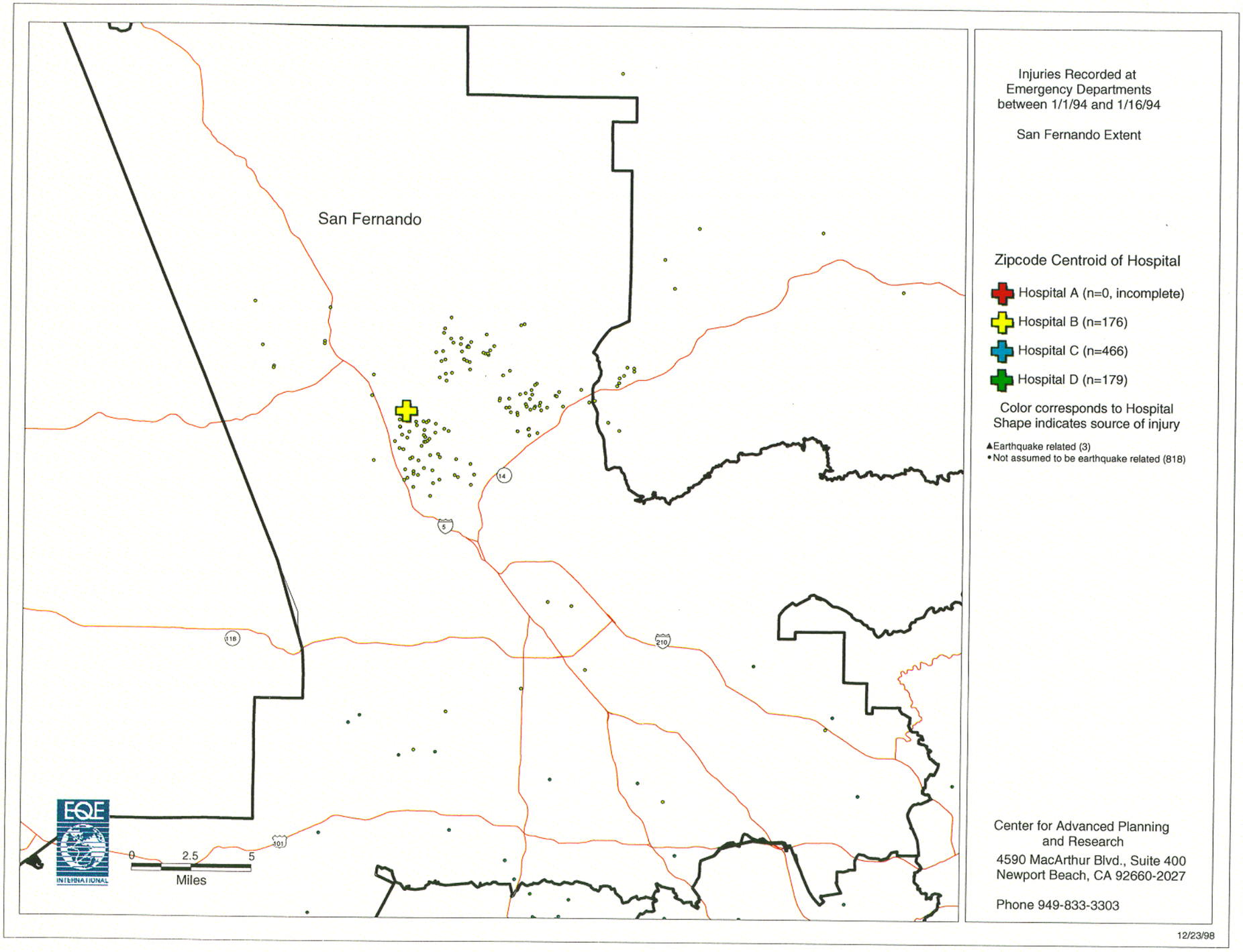
Figure A-3. Map Presenting Injuries Recorded at Emergency Departments between 1/1/94 and 1/16/94, San Fernando Extent, Los Angeles County.



Injuries Recorded at
Emergency Departments
between 1/1/94 and 1/16/94

San Fernando Extent

Zipcode Centroid of Hospital

- Hospital A (n=0, incomplete)
- Hospital B (n=176)
- Hospital C (n=466)
- Hospital D (n=179)

Color corresponds to Hospital
Shape indicates source of injury

▲Earthquake related (3)
•Not assumed to be earthquake related (818)

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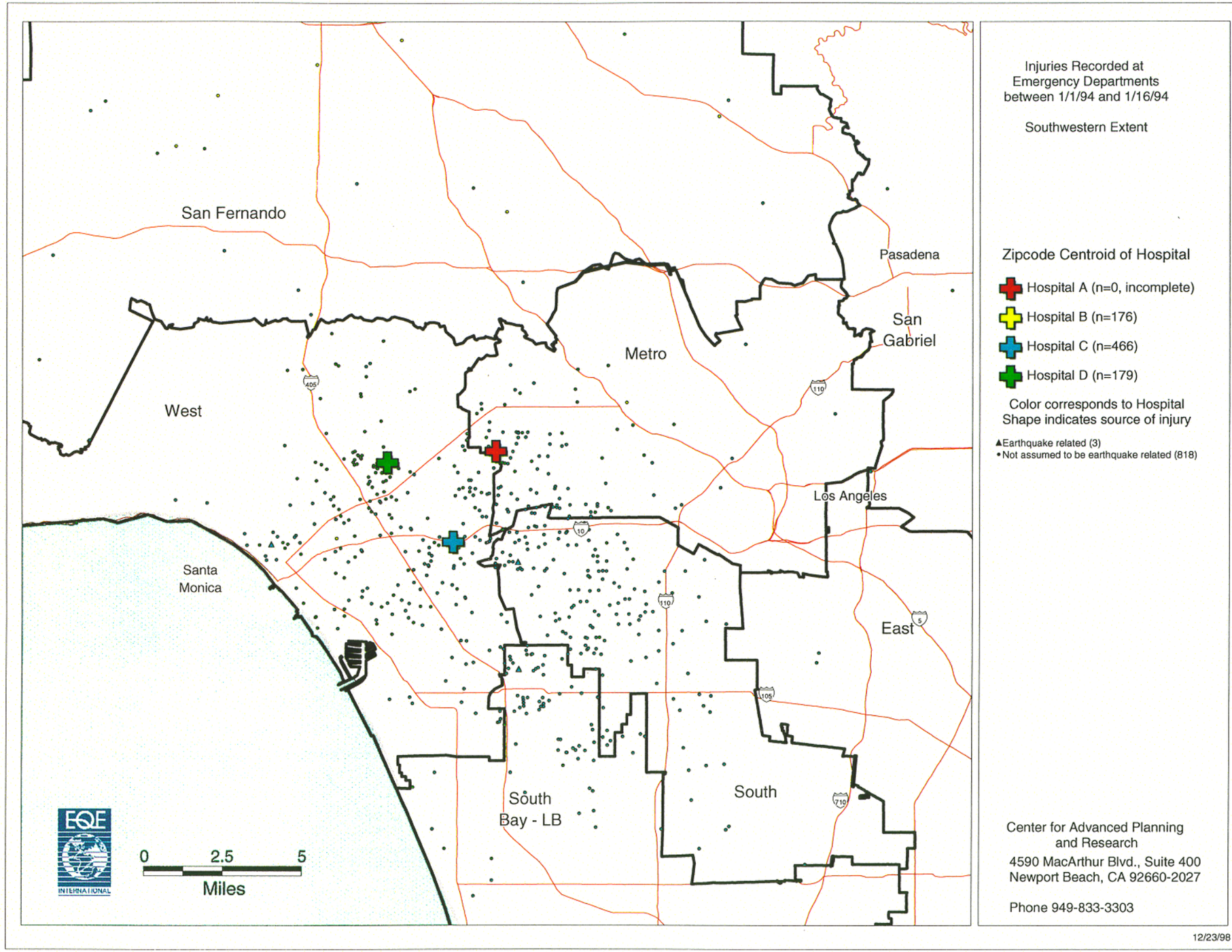
Figure A-4. Map Presenting Injuries Recorded at Emergency Departments between 1/1/94 and 1/16/94, Southwestern Extent, Los Angeles County.



Injuries Recorded at Emergency Departments between 1/1/94 and 1/16/94

Southwestern Extent

Zipcode Centroid of Hospital

- Hospital A (n=0, incomplete)
- Hospital B (n=176)
- Hospital C (n=466)
- Hospital D (n=179)

Color corresponds to Hospital
Shape indicates source of injury

▲Earthquake related (3)
•Not assumed to be earthquake related (818)

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Figure A-5. Map Presenting Modified Mercalli Intensity Boundaries and Injuries Recorded at Emergency Departments between 1/17/94 and 1/31/94 following the 1994 Northridge Earthquake, Regional Extent, Los Angeles County.

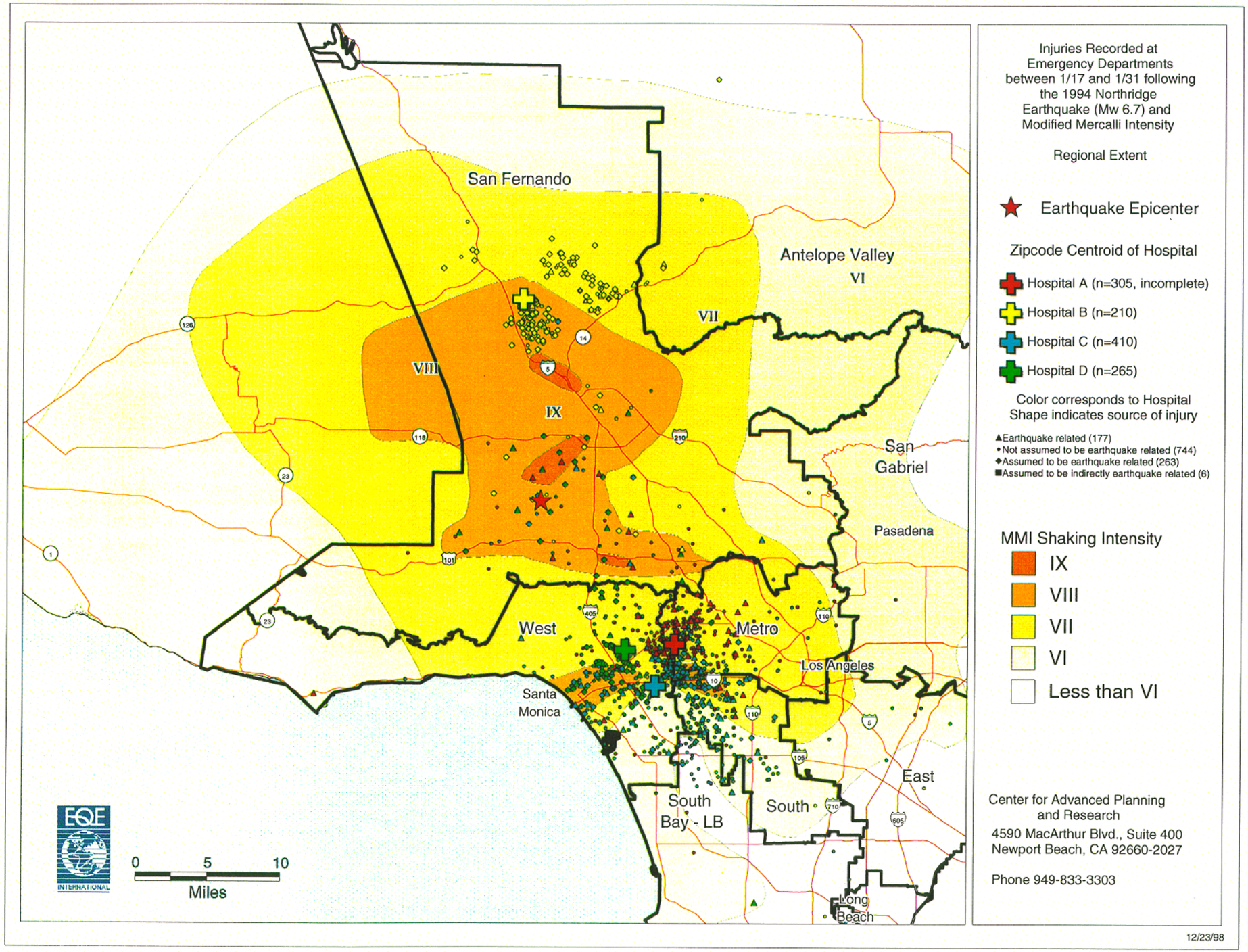
San Fernando
Antelope Valley
VI
VII
VIII
IX
San Gabriel
Pasadena
West
Metro
Los Angeles
Santa Monica
South Bay - LB
South
East
Long Beach
0 5 10
Miles
Injuries Recorded at Emergency Departments between 1/17 and 1/31 following the 1994 Northridge Earthquake (Mw 6.7) and Modified Mercalli Intensity
Regional Extent
Earthquake Epicenter
Zipcode Centroid of Hospital
Hospital A (n=305, incomplete)
Hospital B (n=210)
Hospital C (n=410)
Hospital D (n=265)
Color corresponds to Hospital
Shape indicates source of injury
▲Earthquake related (177)
•Not assumed to be earthquake related (744)
◆Assumed to be earthquake related (263)
■Assumed to be indirectly earthquake related (6)
MMI Shaking Intensity
IX
VIII
VII
VI
Less than VI
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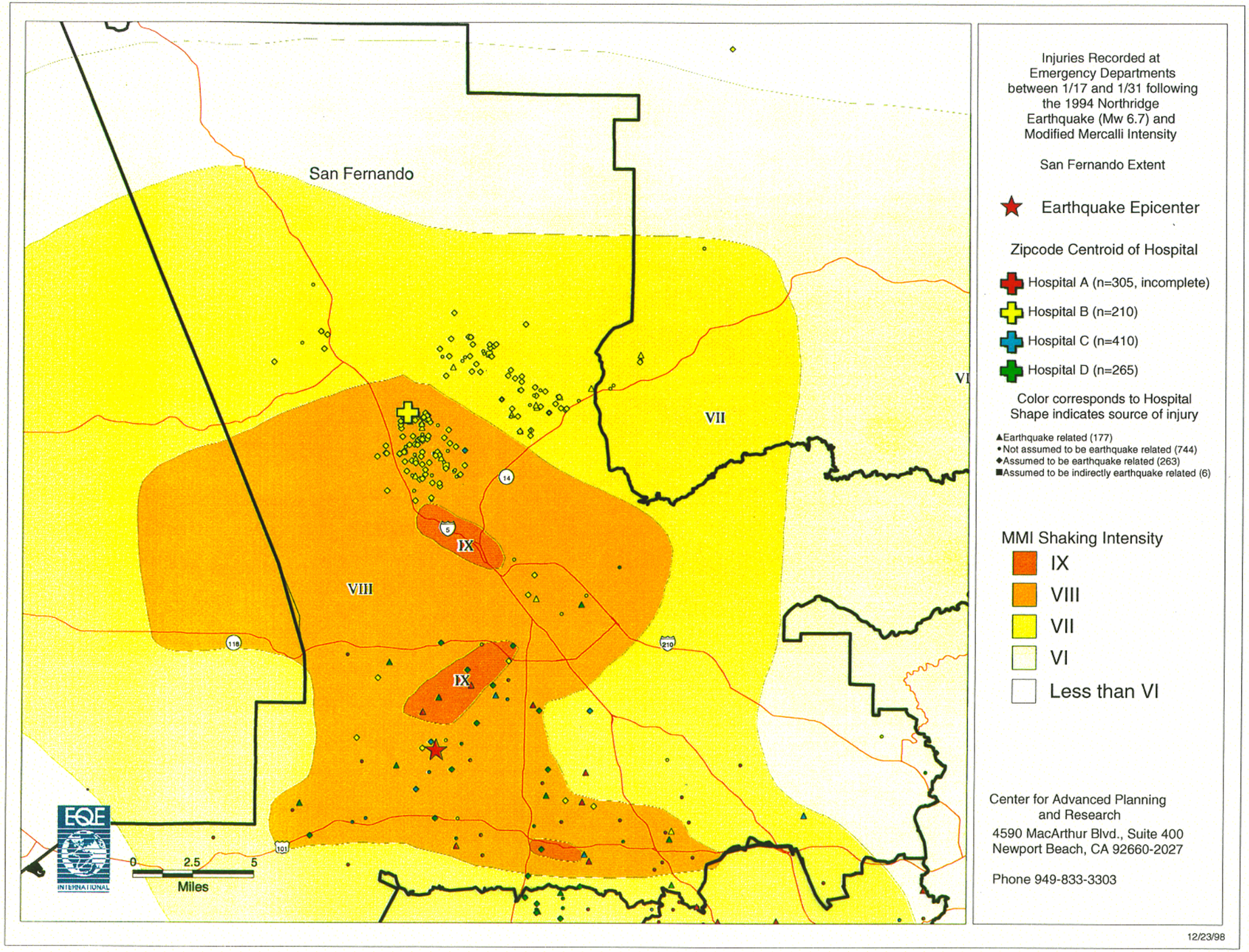
Figure A-6. Map Presenting Modified Mercalli Intensity Boundaries and Injuries Recorded at Emergency Departments between 1/17/94 and 1/31/94 following the 1994 Northridge Earthquake, San Fernando Extent, Los Angeles County.



Injuries Recorded at Emergency Departments between 1/17 and 1/31 following the 1994 Northridge Earthquake (Mw 6.7) and Modified Mercalli Intensity

San Fernando Extent

Earthquake Epicenter

Zipcode Centroid of Hospital

- Hospital A (n=305, incomplete)
- Hospital B (n=210)
- Hospital C (n=410)
- Hospital D (n=265)

Color corresponds to Hospital
Shape indicates source of injury

- ▲Earthquake related (177)
- •Not assumed to be earthquake related (744)
- ◆Assumed to be earthquake related (263)
- ■Assumed to be indirectly earthquake related (6)

MMI Shaking Intensity

- IX
- VIII
- VII
- VI
- Less than VI

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Figure A-7. Map Presenting Modified Mercalli Intensity Boundaries and Injuries Recorded at Emergency Departments between 1/17/94 and 1/31/94 following the 1994 Northridge Earthquake, Southwestern Extent, Los Angeles County.

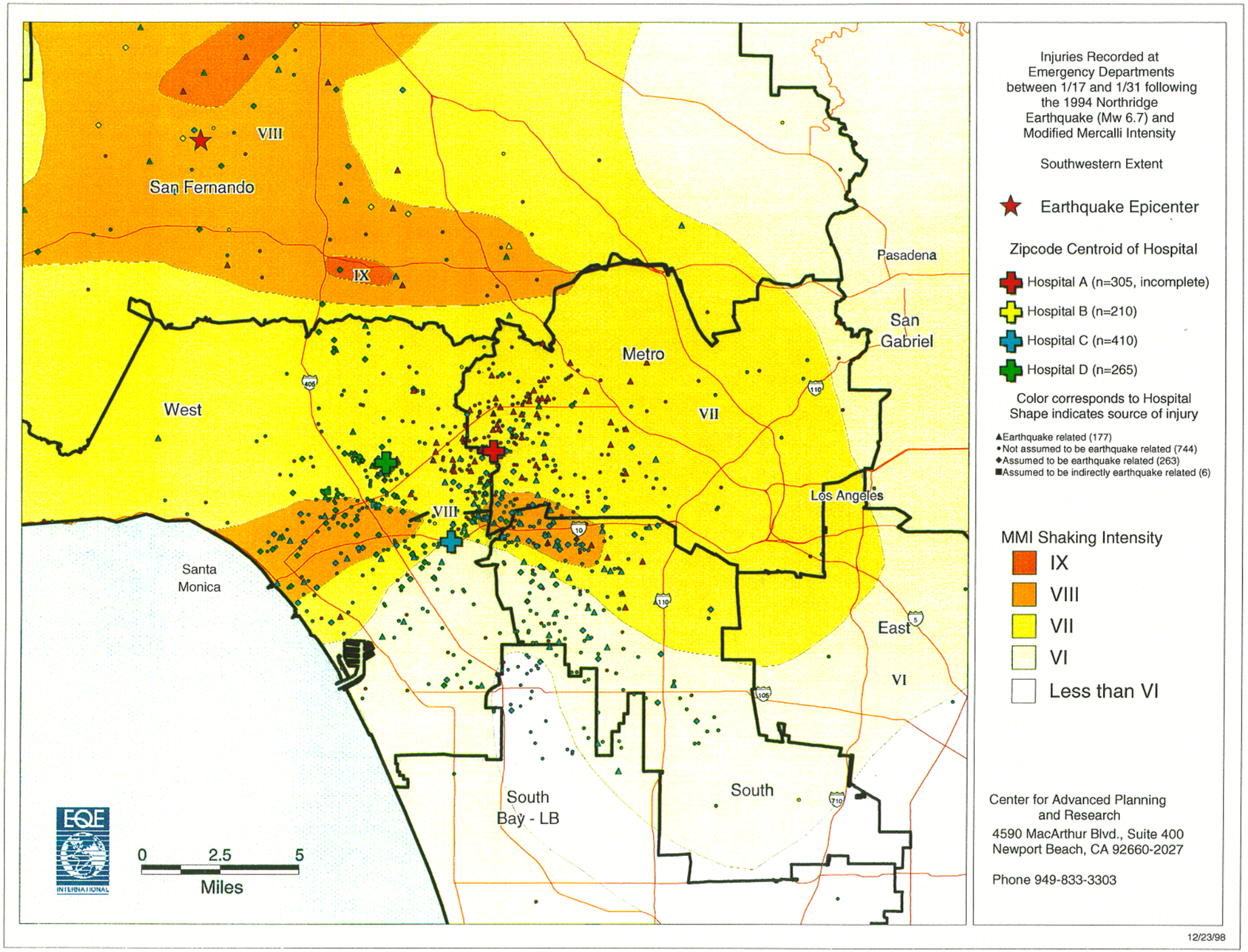
Injuries Recorded at Emergency Departments between 1/17 and 1/31 following the 1994 Northridge Earthquake (Mw 6.7) and Modified Mercalli Intensity
Southwestern Extent
Earthquake Epicenter
Zipcode Centroid of Hospital
Hospital A (n=305, incomplete)
Hospital B (n=210)
Hospital C (n=410)
Hospital D (n=265)
Color corresponds to Hospital
Shape indicates source of injury
▲Earthquake related (177)
•Not assumed to be earthquake related (744)
◆Assumed to be earthquake related (263)
■Assumed to be indirectly earthquake related (6)
MMI Shaking Intensity
IX
VIII
VII
VI
Less than VI
San Fernando
VIII
IX
Pasadena
San Gabriel
Metro
West
VII
Los Angeles
VIII
Santa Monica
East
VI
South Bay - LB
South
0 2.5 5
Miles
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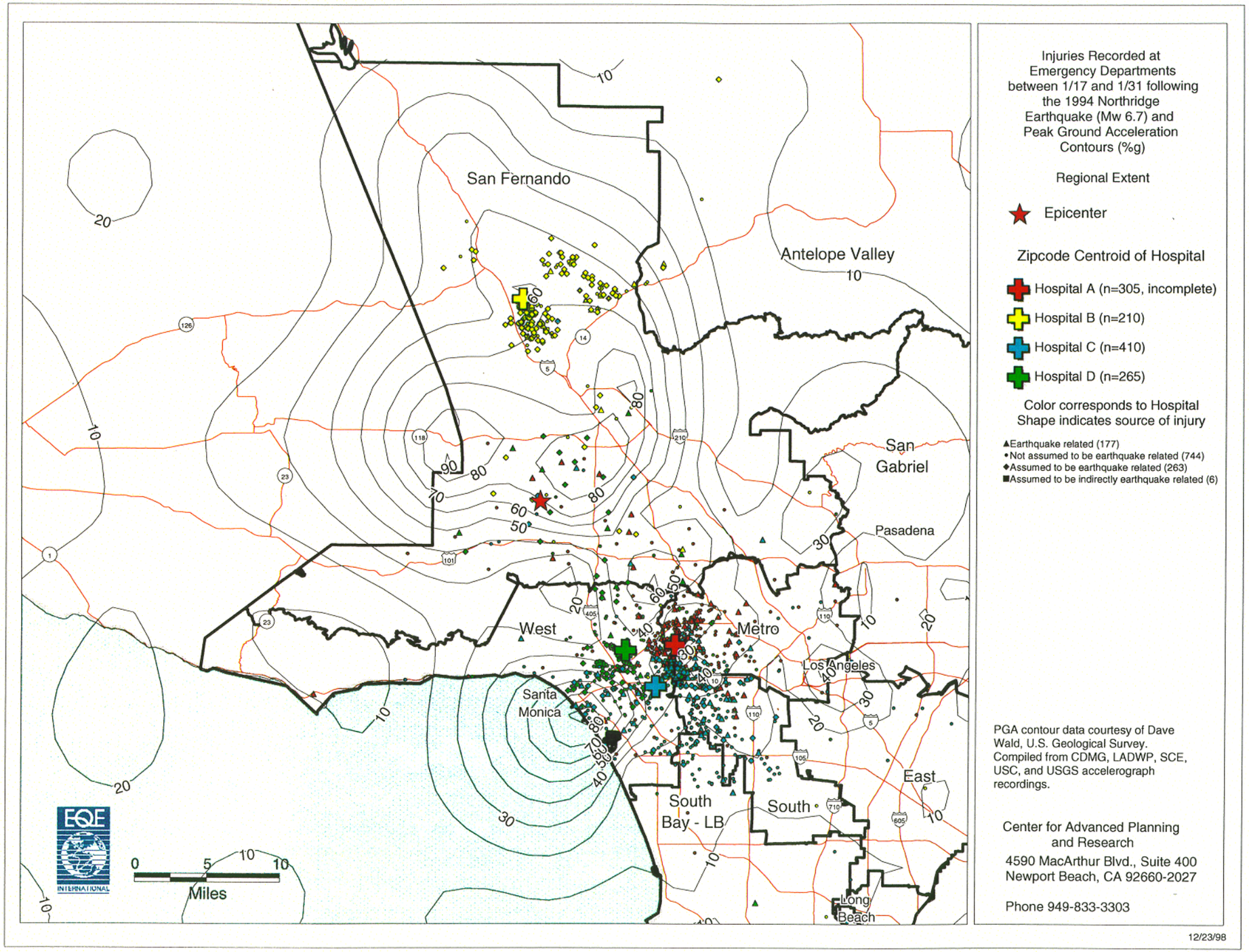
Figure A-8. Map Presenting Peak Ground Acceleration Contours and Injuries Recorded at Emergency Departments between 1/17/94 and 1/31/94 following the 1994 Northridge Earthquake, Regional Extent, Los Angeles County.



Injuries Recorded at Emergency Departments between 1/17 and 1/31 following the 1994 Northridge Earthquake (Mw 6.7) and Peak Ground Acceleration Contours (%g)

Regional Extent

★ Epicenter

Zipcode Centroid of Hospital

- Hospital A (n=305, incomplete)
- Hospital B (n=210)
- Hospital C (n=410)
- Hospital D (n=265)

Color corresponds to Hospital
Shape indicates source of injury

- ▲Earthquake related (177)
- •Not assumed to be earthquake related (744)
- ◆Assumed to be earthquake related (263)
- ■Assumed to be indirectly earthquake related (6)

PGA contour data courtesy of Dave Wald, U.S. Geological Survey. Compiled from CDMG, LADWP, SCE, USC, and USGS accelerograph recordings.

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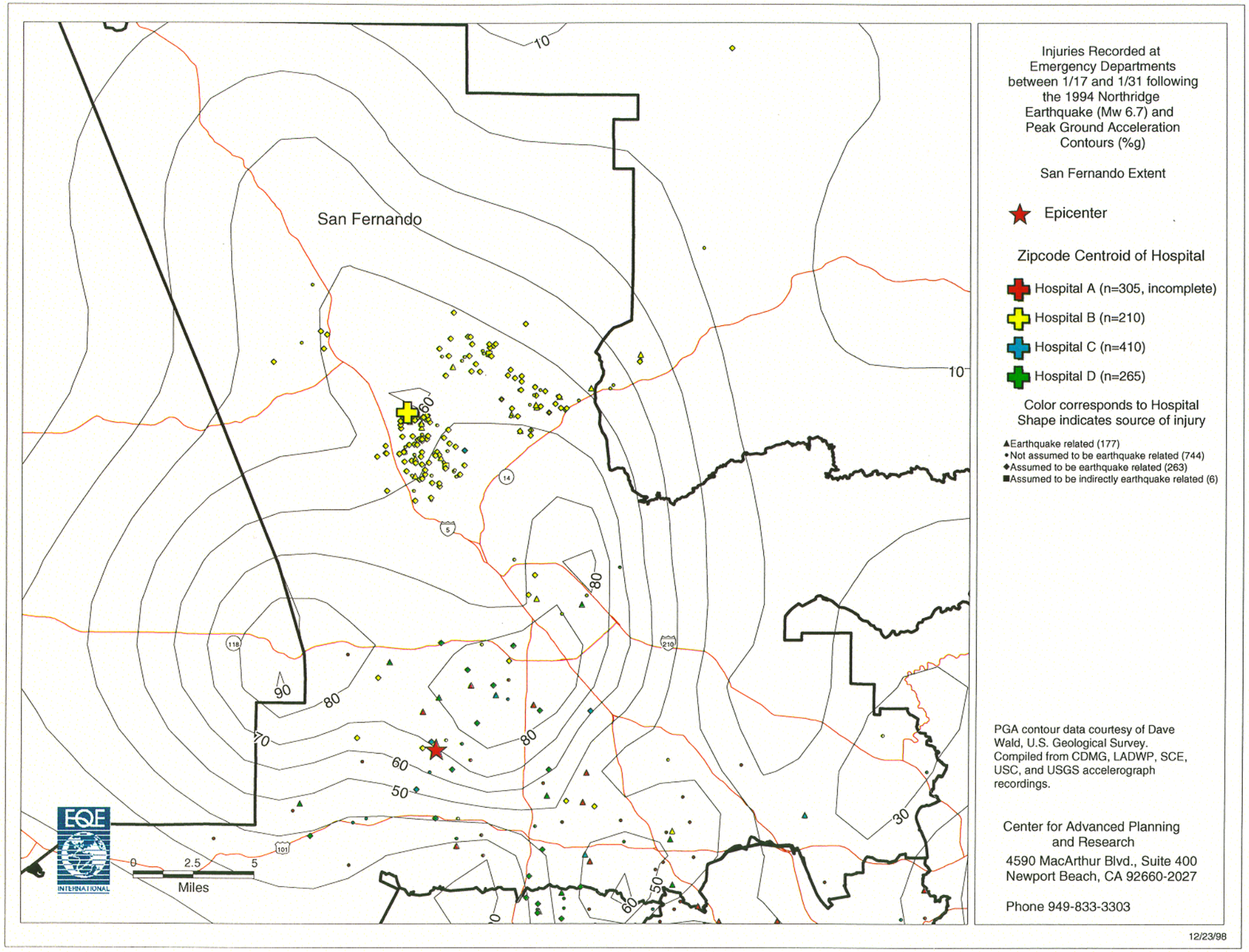
Figure A-9. Map Presenting Peak Ground Acceleration Contours and Injuries Recorded at Emergency Departments between 1/17/94 and 1/31/94 following the 1994 Northridge Earthquake, San Fernando Extent, Los Angeles County.



Injuries Recorded at Emergency Departments between 1/17 and 1/31 following the 1994 Northridge Earthquake (Mw 6.7) and Peak Ground Acceleration Contours (%g)

San Fernando Extent

Epicenter

Zipcode Centroid of Hospital

- Hospital A (n=305, incomplete)
- Hospital B (n=210)
- Hospital C (n=410)
- Hospital D (n=265)

Color corresponds to Hospital
Shape indicates source of injury

- ▲Earthquake related (177)
- •Not assumed to be earthquake related (744)
- ◆Assumed to be earthquake related (263)
- ■Assumed to be indirectly earthquake related (6)

PGA contour data courtesy of Dave Wald, U.S. Geological Survey. Compiled from CDMG, LADWP, SCE, USC, and USGS accelerograph recordings.

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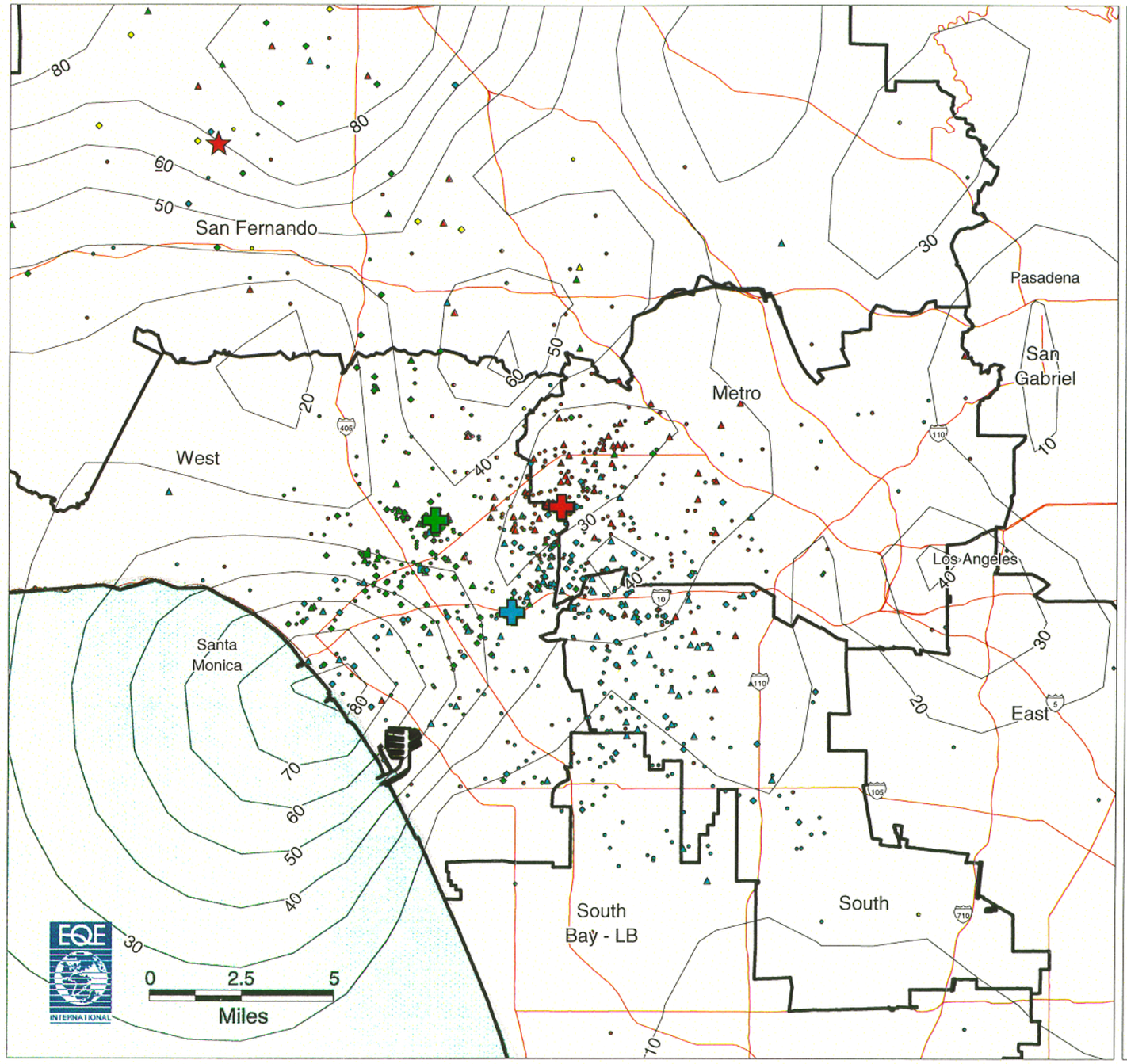
Figure A-10. Map Presenting Peak Ground Acceleration Contours and Injuries Recorded at Emergency Departments between 1/17/94 and 1/31/94 following the 1994 Northridge Earthquake, Southwestern Extent, Los Angeles County.



Injuries Recorded at Emergency Departments between 1/17 and 1/31 following the 1994 Northridge Earthquake (Mw 6.7) and Peak Ground Acceleration Contours (%g)

Southwestern Extent

Epicenter

Zipcode Centroid of Hospital

- Hospital A (n=305, incomplete)
- Hospital B (n=210)
- Hospital C (n=410)
- Hospital D (n=265)

Color corresponds to Hospital
Shape indicates source of injury

- ▲Earthquake related (177)
- •Not assumed to be earthquake related (744)
- ◆Assumed to be earthquake related (263)
- ■Assumed to be indirectly earthquake related (6)

PGA contour data courtesy of Dave Wald, U.S. Geological Survey. Compiled from CDMG, LADWP, SCE, USC, and USGS accelerograph recordings.

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APPENDIX 6

Table A-8. Polytomous Logistic Regression: Demographic Model Development and Likelihood Ratio Tests.

Model #	Model Variable(s)	n	-2 * Log Likelihood	df~	Chi-Sq. LRT^	Chi-Sq. LRT p-value	Chi-Sq. Proportional Odds p-value
1	Gender	641	765.207	1	8.175	0.0042	0.885
2	Ethnicity*	420	548.189	2	2.952	0.2285	0.1479
3	Age (Trend)	634	743.356	1	26.997	0.0001	0.0516
4	Age Grouped	634	742.204	5	28.149	0.0001	0.2508
5**	Gender, Ethnicity, Age Group, Hospital	418	518.443	10	31.706	0.0004	0.2966
6	Gender, Ethnicity, Age Group Trend, Hospital	418	520.129	6	30.021	0.0001	0.2502
7	Gender	418	547.567	1	2.583	0.108	0.6638
8	Ethnicity	418	547.332	2	2.818	0.2443	0.1471
9	Age Group	418	533.096	5	17.054	0.0044	0.1909
10	Age (Trend)	418	534.622	1	15.488	0.0001	0.1336
11	Hospital	418	538.411	2	11.739	0.0028	0.6276
12	Deleted Gender from Model 5	418	518.994	9	31.156	0.0003	0.3458
13	Deleted Ethnicity from Model 5	418	521.719	8	28.431	0.0004	0.2734
14	Deleted Age Group from Model 5	418	533.17	5	16.98	0.0045	0.516
14-t	Deleted Age Group Trend from Model 6	418	533.17	5	16.98	0.0045	0.516
15	Deleted Hospital from Model 5	418	529.839	8	20.311	0.0092	0.2018
	Compare Model 12 to 5 (Gender | Ethnicity, Age, Hospital)	418		1	0.55	n.s.***	
	Compare Model 13 to 5 (Ethnicity | Gender, Age, Hospital)	418		2	3.275	n.s.***	
	Compare Model 14 to 5 (Age | Gender, Ethnicity, Hospital)	418		5	14.726	$p < 0.025$	
	Compare Model 14-t to 6 (Age Trend | Gender, Ethnicity, Hospital)	418		1	13.041	$p < 0.0005$	
	Compare Model 15 to 5 (Hospital | Gender, Ethnicity, Age)	418		2	11.395	$p < 0.005$	
Interactions							
16	#5 with AA*Female Interaction	418	518.429	11	31.721	0.0008	0.3355
17	#5 with Hisp*Female Interaction	418	516.555	11	33.595	0.0004	0.3887
18	#5 with Twenty*Female Interaction	418	516.562	11	33.587	0.0004	0.2869

Table A-8. (Continued)

Model #	Model Variable(s)	n	-2 * Log Likelihood	df~	Chi-Sq. LRT^	Chi-Sq. LRT p-value	Chi-Sq. Proportional Odds p-value
19	#5 with Fourty*Female Interaction	418	518.061	11	32.089	0.0007	0.3142
20	#5 with Fifty*Female Interaction	418	518.306	11	31.844	0.0008	0.2677
21	#5 with Age-gt-Sixty*Female Interaction	418	516.106	11	34.044	0.0004	0.0401
22	#5 with Age-lt-20*Female Interaction	418	518.428	11	31.722	0.0008	0.3754
	Compare Model 16 to 5 (AA*Female Interaction)	418		1	0.015	n.s.***	
	Compare Model 17 to 5 (Hisp*Female Interaction)	418		1	1.889	n.s.***	
	Compare Model 18 to 5 (20's*Female Interaction)	418		1	1.881	n.s.***	
	Compare Model 19 to 5 (40's*Female Interaction)	418		1	0.383	n.s.***	
	Compare Model 20 to 5 (50's*Female Interaction)	418		1	0.138	n.s.***	
	Compare Model 21 to 5 (>=60*Female Interaction)	418		1	2.338	n.s.***	
	Compare Model 22 to 5 (<20*Female Interaction)	418		1	0.016	n.s.***	

~ df=Degrees of Freedom

^ LRT=Likelihood Ratio Test; for interaction models 16-22, Chi-Square LRT on 1 df = difference in likelihoods from interaction model versus model 5.

* Deleted Ethnicity='Other' from Polytomous Model, no observations in ISS=8 group.

** Core Demographic Model, Final Demographic Model

***n.s.= $p \geq 0.05$ (not statistically significant)

Table A-9. Dichotomous Logistic Regression Model Development: Demographic Characteristics of Patients Identified with Earthquake-Related Injuries from 4 Emergency Departments, Los Angeles County, January 17-31, 1994.

Model #	Model Variable(s)	n	-2 * Log Likelihood	df~	Chi-Sq. LRT^	Chi-Sq. LRT p-value
1	Gender	641	621.658	1	8.039	0.0046
2	Ethnicity*	440	451.877	3	4.610	0.2027
3	Age (Trend)	634	602.327	1	24.343	0.0001
4	Age Grouped	634	601.563	5	25.106	0.0001
5**	Gender, Ethnicity, Age Group, Hospital	438	423.328	11	32.195	0.0007
5-t	Gender, Ethnicity, Age Group Trend, Hospital	438	424.860	7	30.663	0.0001
6	Gender	438	452.383	1	3.140	0.0764
7	Ethnicity	438	451.010	3	4.513	0.2112
8	Age Group	438	439.914	5	15.609	0.0081
9	Age Group Trend	438	441.157	1	14.366	0.0002
10	Hospital	438	443.015	2	12.508	0.0019
11	Deleted Gender from Model 5	438	424.126	10	31.397	0.0005
12	Deleted Ethnicity from Model 5	438	427.724	8	27.799	0.0005
13	Deleted Age Group from Model 5	438	435.730	6	19.793	0.0030
13-t	Deleted Age Group Trend from Model 5-t	438	435.730	6	19.793	0.0030
14	Deleted Hospital from Model 5	438	435.004	9	20.519	0.0150
	Compare Model 11 to 5 (Gender | Ethnicity, Age, Hospital)			1	0.798	n.s.
	Compare Model 12 to 5 (Ethnicity | Gender, Age, Hospital)			3	4.396	n.s.
	Compare Model 13 to 5 (Age | Gender, Ethnicity, Hospital)			5	12.402	$p < 0.05$
	Compare Model 13-t to 5-t (Age Trend | Gender, Ethnicity, Hospital			1	10.870	$p < 0.005$
	Compare Model 14 to 5 (Hospital | Gender, Ethnicity, Age)			2	11.676	$p < 0.005$
Interactions						
15	Model 5 with Ethnicity x Sex Interaction	438	423.247	12	32.276	0.0013
16	Model 5 with Ethnicity x Age Interaction	438	423.327	12	32.195	0.0013
17	Model 5 with Sex x Age Interaction	438	420.525	12	34.998	0.0005
	Compare Model 15 to 5 (Ethnicity x Sex Interaction)	438		1	0.081	n.s.
	Compare Model 16 to 5 (Ethnicity x Age Interaction)	438		1	0.000	n.s.
	Compare Model 16 to 5 (Sex x Age Interaction)	438		1	2.803	n.s.

~ df=Degrees of Freedom
^LRT=Likelihood Ratio Test; for interaction models 15-17, Chi-Square LRT on 1 df=difference in likelihoods from interaction model versus model 5.
*Deleted Ethnicity='Other' from Polytomous Model, no observations in ISS=8 group.
**Core Demographic Model
***n.s.=not statistically significant

Table A-10. Polytomous Logistic Regression: Model Development

Model #	Model Variable(s)	n	-2 x Log Likelihood	df~	Chi-Sq. LRT^	Chi-Sq. LRT p-value	Chi-Sq. Proportional Odds p-value
Body Location -- missing values excluded (n=637)							
1	Head/Neck	637	767.638	1	4.018	0.045	0.2016
2	Upper Extremities	637	765.257	1	6.399	0.0114	0.1605
3	Lower Extremities	637	769.963	1	1.692	0.1933	0.3537
4	Trunk (Back, Chest, Abd, Trunk)	637	768.68	1	2.976	0.0845	0.0256
5	Head/Neck, Upper Ext, Trunk (Lower Ext is Reference Category)	637	760.142	3	11.513	0.0093	0.0481
External Cause - missing, unknown, other, mv, poison, fire, burn, overexertion values excluded (n=512)							
6	Cut/Pierced by	512	575.424	1	21.707	0.0001	0.4766
7	Falls	512	549.324	1	47.807	0.0001	0.7866
8	Struck by/Caught in/Caught between	512	590.537	1	6.595	0.0102	0.8853
9	Falls, Cut/Pierced (Struck by as reference category)	512	546.661	2	50.47	0.0001	0.8398
Body Location and External Cause - missing, unknown excluded, specified mechanisms excluded (n=512)							
10	Body Location (4 Groups) & Mechanism (3 Groups)	512	539.373	5	57.758	0.0001	0.2629
11	Body Location (4 Groups)	512	584.396	3	12.736	0.0052	0.2143
	Model 10 Compared to Model 9 (Body Location | Mechanism)	512		3	7.288	n.s.**	
	Model 10 Compared to Model 11 (Mechanism | Body Location)	512		2	45.022	p < 0.0005	
Interactions							
12	Model 10 plus Fell-Arm Interaction	512	538.875	6	58.256	0.0001	0.0452
13	Model 10 plus Fell-Head Interaction	512	539.007	6	58.125	0.0001	0.3411
14	Model 10 plus Fell-Body Interaction	512	538.074	6	59.058	0.0001	0.2295
15	Model 10 plus Cut-Foot Interaction	512	537.471	6	59.661	0.0001	0.3064
16	Model 10 plus Cut-Head Interaction	512	538.868	6	58.264	0.0001	0.2902
17	Model 10 plus Cut-Arm Interaction	512	539.366	6	57.765	0.0001	0.2155
	Compare Model 10 to Model 12	512		1	0.498	n.s.**	
	Compare Model 10 to Model 13	512		1	0.366	n.s.**	
	Compare Model 10 to Model 14	512		1	1.299	n.s.**	
	Compare Model 10 to Model 15	512		1	1.902	n.s.**	
	Compare Model 10 to Model 16	512		1	0.505	n.s.**	
	Compare Model 10 to Model 17	512		1	0.007	n.s.**	
Demographics, Body Location and External Cause							
18	Gender	330	407.31	1	2.187	0.1392	0.9577
19	Ethnicity	330	408.937	2	0.56	0.7556	0.3817
20	Age	330	391.144	5	18.354	0.0025	0.5013

Table A-10. (Continued)

Model #	Model Variable(s)	n	-2 x Log Likelihood	df~	Chi-Sq. LRT^	Chi-Sq. LRT p-value	Chi-Sq. Proportional Odds p-value
20-t	Age Group Trend	330	393.232	1	16.265	0.0001	0.0744
21	Mechanism	330	375.871	2	33.627	0.0001	0.8257
22	Body Location	330	400.662	3	8.835	0.0316	0.1053
23	Hospital	330	403.239	2	6.259	0.0437	0.8506
24*	Gender, Ethnicity, Age, Body Location, Mechanism, Hospital	330	353.317	15	56.181	0.0001	0.1382
24-t	Gender, Ethnicity, Age Group Trend, Body Location, Mecanism., Hospital	330	355.849	11	53.648	0.0001	0.1543
25	Deleted Gender from Model 24	330	353.318	14	56.18	0.0001	0.2369
26	Deleted Ethnicity from Model 24	330	355.902	13	53.595	0.0001	0.2791
27	Deleted Age from Model 24	330	363.314	10	46.184	0.0001	0.1856
28	Deleted Body Location from Model 24	330	359.028	12	50.469	0.0001	0.489
29	Deleted Mechanism from Model 24	330	376.445	13	33.053	0.0017	0.1233
30	Deleted Hospital from Model 24	330	358.705	13	50.793	0.0001	0.184
	Compare Model 25 to 24 (Gender | Ethnic, Age, Body Loc, Mech, Hosp)	330		1	0.001	n.s.**	
	Compare Model 26 to 24 (Ethnicity | Gender, Age, Body Loc, Mech, Hosp)	330		2	2.586	n.s.**	
	Compare Model 27 to 24 (Age | Gender, Ethnic, Body Loc, Mech, Hosp)	330		5	9.997	n.s.**	
	Compare Model 27 to 24-t (Age Trend|Gender, Ethnic, Body Loc, Mech,	330		1	7.464	p < 0.01	
	Compare Model 28 to 24 (Body Loc | Gender, Ethnic, Age, Mech, Hosp)	330		3	5.712	n.s.**	
	Compare Model 29 to 24 (Mechanism | Gender, Ethnic, Age, Body Loc, Hosp)	330		2	23.128	p < 0.0005	
	Compare Model 30 to 24 (Hospital | Gender, Ethnic, Age, Body Loc, Mech)	330		3	5.388	n.s.**	

~d.f.=Degress of Freedom

^ LRT=Likelihood Ratio Test; for interaction models 12-17, Chi-Square LRT on 1 df = difference in likelihoods from interaction model versus model 10.

*Core Model, Final Model

**n.s.=not statistically significant

Table A-11. Dichotomous Logistic Regression Model Development: Injury & Demographic Characteristics with Respect to Severity of Earthquake-Related Injury.

Model #	Model Variable(s)	n	-2 x Log Likelihood	df~	Chi-Sq. LRT^	Chi-Sq. LRT p-value
Body Location -- missing & unknown values excluded (n=637)						
1	Head/Neck, Upper Ext, Trunk (Lower Ext is Reference Category)	637	616.552	3	11.42	0.0097
External Cause - missing, unknown, other, mv, poison, fire, burn, overexertion values excluded (n=512)						
2	Falls, Cut/Pierced, Slip/Trip, Motor-vehicle collisions, poisonings, overexertion (Struck by as reference category)	555	490.800	6	61.862	0.0001
Body Location and External Cause (n=553)						
3	Body Location	553	538.051	3	13.727	0.0033
4	Mechanism of Injury	553	489.155	6	62.623	0.0001
5*	Body Location & Mechanism of Injury	553	480.589	9	71.188	0.0001
	Model 3 Compared to Model 5 (Mechanism of Injury | Body Location)	553		6	57.461	$p < 0.0005$
	Model 4 Compared to Model 5 (Body Location | Mechanism of Injury)	553		3	8.565	$p < 0.05$
Interactions						
6	Body Location, Mechanism, & Interaction	553	480.496	10	71.282	0.0001
	Model 6 Compared to Model 5 (Body Location x Mechanism Interaction)	553		1	0.094	n.s.**
Demographics, Body Location and External Cause						
7	Gender	375	386.441	1	2.314	0.1282
8	Ethnicity	375	386.425	3	2.33	0.5067
9	Age	375	371.831	5	16.924	0.0046
10	Age Group Trend	375	373.288	1	15.467	0.0001
11	Hospital	375	378.178	2	10.577	0.005
12	Body Location	375	377.477	3	11.278	0.0103
13	Mechanism of Injury	375	346.468	6	42.287	0.0001
14^^	Gender, Ethnicity, Age, Body Location, Mechanism, Hospital	375	318.974	20	69.78	0.0001
14-t	Gender, Ethnicity, Age Group Trend, Body Location, Mechanism, Hospital	375	321.218	16	67.537	0.0001
15	Deleted Gender from Model 14	375	318.989	19	69.766	0.0001
16	Deleted Ethnicity from Model 14	375	322.012	17	66.743	0.0001
17	Deleted Age from Model 14	375	328.193	15	60.562	0.0001
18	Deleted Body Location from Model 14	375	327.583	17	61.171	0.0001
19	Deleted Mechanism from Model 14	375	349.724	14	39.031	0.0004
20	Deleted Hospital from Model 14	375	326.776	18	61.978	0.0001
	Compare Model 15 to 14 (Gender | Ethnic, Age, Body Loc, Mech, Hosp)	375		1	0.014	n.s.**
	Compare Model 16 to 14 (Ethnicity | Gender, Age, Body Loc, Mech, Hosp)	375		3	3.037	n.s.**
	Compare Model 17 to 14 (Age | Gender, Ethnic, Body Loc, Mech, Hosp)	375		5	9.218	n.s.**
	Compare Model 18 to 14 (Body Loc | Gender, Ethnic, Age, Mech, Hosp)	375		3	8.609	$p < 0.05$
	Compare Model 19 to 14 (Mechanism | Gender, Ethnic, Age, Body Loc, Hosp)	375		6	30.749	$p < 0.0005$
	Compare Model 10 to 14 (Hospital | Gender, Ethnic, Age, Body Loc, Mech)	375		2	7.802	$p < 0.025$

~d.f.=Degress of Freedom

^LRT=Likelihood Ratio Test; for interaction models 6, Chi-Square LRT on 1 df=difference in likelihoods from interaction model versus model 5.

* Core Model

**n.s.=not statistically significant

^^ Final Model

Table A-12. Polytomous Logistic Regression: Structural Characteristics, Model Development.

Model #	Model Variables	n	-2 * Log Likelihood	df	Chi-Sq. LRT	Chi-Sq. LRT p-value	Chi-Sq. Prop. Odds Assump p value
Square Footage							
1	Square Footage - Building (Quartiles - Trend)	415	511.437	1	1.127	0.2885	0.3939
2	Square Footage - Building (Quartiles - Less than 1468 sq. ft. as reference category)	415	511.387	3	1.177	0.7585	0.4608
3	Square Footage - Unit (Quartiles - Trend)	415	512.564	1	0.000	0.9946	0.2058
4	Square Footage - Unit (Quartiles - Less than 1350 sq. ft. as reference category)	415	511.207	3	1.357	0.7156	0.3611
Tagging							
5	Tagging (Green Tags as reference category)	100	119.086	1	0.059	0.8079	0.1798
6	Tagging (Untagged as reference category)	608	730.052	2	0.757	0.6848	0.0001
Structure Construction Type							
7	Wood-Framed Structures (Missing, Other, Steel Frame, Concrete Frame, URM, Special as reference category)	641	772.133	1	1.249	0.2638	0.5083
Year Built							
8	Year Built (5 Categories Based on Code Revisions - Trend)	413	503.803	1	2.300	0.1294	0.7934
9	Year Built (5 Categories Based on Code Revisions - GE 1988 as reference category)	413	500.892	4	5.210	0.2664	0.9018
10	Year Built (4 Categories Based on Shoaf Paper - GE 1976 as reference	413	502.867	3	3.235	0.3568	0.3094
11	Year Built (4 Categories Based on Collapsing Top 2 Categories from Model # 8 - Trend)	413	504.69	1	1.412	0.2347	0.8099
12	Year Built (4 Categories Based on Collapsing Top 2 Categories from Model # 8 - GE 1976 as reference category)	413	502.872	3	3.230	0.3574	0.8339
Structure Use							
13	Multifamily Condos/Apts/Coops (Single Family & Duplexes as reference category)	405	490.952	1	2.621	0.1054	0.837
14	Use Coded (All Others as reference category)	641	773.382	1	0.000	0.9989	0.3571
All Structural Characteristics (Reduced Model)							
15	Mx-fam Use, Year Built, Sq Ft Bldg, Sq Ft Unit	393	472.993	10	11.883	0.293	0.9241
16	Year Built, Sq Ft Bldg, Sq Ft Unit	393	479.304	9	5.572	0.7819	0.9166

Table A-12. (Continued)

Model #	Model Variables	n	-2 * Log Likelihood	df	Chi-Sq. LRT	Chi-Sq. LRT p-value	Chi-Sq. Prop. Odds Assump p value
17	Mx-fam Use, Sq Ft Bldg, Sq Ft Unit	393	476.638	7	8.238	0.3121	0.8473
18	Mx-fam Use, Year Built, Sq Ft Unit	393	477.166	7	7.710	0.3589	0.8611
19	Mx-fam Use, Year Built, Sq Ft Bldg	393	473.458	7	11.418	0.1214	0.9373
	Compare Model 16 to Model 15 (Mx-fam use | Year Built & Sq Ft)	393		1	6.311	p < 0.025	
	Compare Model 17 to Model 15 (Yr Blt | Use, Sq Ft)	393		3	3.645	n.s.	
	Compare Model 18 to Model 15 (Sq Ft Bldg | Yr Blt, Use, Sq Ft Unit)	393		3	4.173	n.s.	
	Compare Model 19 to Model 15 (Sq Ft Unit | Yr Blt, Use, Sq Ft Bldg)	393		3	0.465	n.s.	
Structural Characteristics (Reduced Model) with Interactions							
20	Use, Yr Blt, Sq Ft Bldg, Sq Ft Unit, Yr Blt * Use Interaction	393	467.771	11	17.105	0.1048	0.9485
	Compare Model 20 to Model 15	393		1	5.222	p < 0.025	
Main Effects, Reduced Model							
21	Mx-fam Use	259	344.174	1	0.686	0.4077	0.303
22	Year Built	259	336.085	3	8.775	0.0324	0.9897
22-t	Year Built Trend	259	339.238	1	5.622	0.0177	0.8708
23	Gender	259	341.385	1	3.475	0.0623	0.4932
24	Ethnicity	259	344.847	2	0.013	0.9935	0.5272
25	Age Group	259	337.247	5	7.613	0.1789	0.088
25-t	Age Group Trend	259	337.535	1	7.324	0.0068	0.0573
26	Hospital	259	335.528	2	9.332	0.0094	0.6607
27*	Use, Yr Blt, Gender, Ethnic, Age Gp, Hospital	259	320.945	14	23.914	0.0469	0.4709
27-t	Use, Yr Blt, Gender, Ethnic, Age Gp Trend, Hospital	259	321.266	10	23.594	0.0088	0.5817
27-tt	Use, Yr Blt Trend, Gender, Ethnic, Age Gp, Hospital	259	323.822	12	20.978	0.0507	0.3315
28	Gender Deleted from Model 27	259	322.397	13	22.463	0.0486	0.3862
29	Ethnicity Deleted from Model 27	259	321.288	12	23.572	0.0232	0.338
30	Year Built Deleted from Model 27	259	327.31	11	17.549	0.0926	0.2284
30-t	Year Built Trend Deleted from Model 27-tt	259	327.31	11	17.549	0.0926	0.2284
31	Structure Use Deleted from Model 27	259	322.575	13	22.285	0.0511	0.599
32	Hospital Deleted from Model 27	259	324.748	12	20.112	0.065	0.4667
33	Age Deleted from Model 27	259	325.019	9	19.841	0.0189	0.7934

Table A-12. (Continued)

Model #	Model Variables	n	-2 * Log Likelihood	df	Chi-Sq. LRT	Chi-Sq. LRT p-value	Chi-Sq. Prop. Odds Assump p value
33-t	Age Trend Deleted from Model 27-t	259	325.019	9	19.841	0.0189	0.7934
	Compare Model 28 to 27 (Gender | Use, Yr Blt, Age, Ethnic, Hosp.)	259		1	1.451	n.s.***	
	Compare Model 29 to 27 (Ethnicity | Use, Yr Blt, Age, Gender, Hosp.)	259		2	0.342	n.s.***	
	Compare Model 30 to 27 (Yr Built | Use, Gender, Age, Ethnic, Hosp.)	259		3	6.365	n.s.***	
	Compare Model 30-t to 27-tt (Yr Built Trend | Use, Gender, Age, Ethnic, Hosp)	259		1	3.429	n.s.***	
	Compare Model 31 to 27 (Use | Yr Blt, Age Gp, Ethnic, Gender, Hosp)	259		1	1.629	n.s.***	
	Compare Model 32 to 27 (Hospital | Use, Yr Blt, Gender, Ethnic, Age, Hosp)	259		2	3.802	n.s.***	
	Compare Model 33 to 27 (Age | Use, Yr Blt, Gender, Ethnic, Hosp)	259		5	4.073	n.s.***	
	Compare Model 33-t to 27-t (Age Trend | Use, Yr Blt, Gender, Ethnic, Hosp)	259		1	3.753	n.s.***	
Interaction							
34	Model 27 with Use * Year Built Interaction	259	320.797	15	24.063	0.064	0.522
35**	Model 27 with 3-level interaction	259	319.135	17	25.725	0.0796	0.5726
	Compare Model 34 to 27	259		1	0.149	n.s.***	
	Compare Model 35 to 27	259		3	1.811	n.s.***	
36	Model 35 with Age Trend	259	319.436	13	25.424	0.0203	0.7398
37	Model 35 with Year Built Trend	259	322.703	15	22.156	0.1038	0.4797
Reduced Model with Tagging Information Included with Previously Identified Stat. Signif. Structural Variables							
38	Mx-fam, Yr Blt, Red & Yellow Tags	88	103.699	5	4.539	0.4747	0.4838
39	Model 38 with Old-MxFam, '43-'60-Mx-Fam, & '61-'75-MxFam Interactions	88	101.516	8	6.722	0.5669	0.0001
	Compare Model 39 to Model 38	88		3	2.183	n.s.***	

^ LRT=Likelihood Ratio Test; for interaction models 20, 34, 35, 39, Chi-Square LRT on 1 df = difference in likelihoods from interaction model versus model 15, 27, 27, 38, respectively.
*Core Structural Characteristics, Adjusting for Demographics
** Final Model, retaining interaction because it was previously detected before data reduction.

Table A-13. Model Development: Structural Characteristics and Demographics.

Model #	Model Variables	n	-2 * Log Likelihood	df	Chi-Sq. LRT^^	Chi-Sq. LRT p-value
Square Footage						
1	Square Footage - Building (Quartiles - Trend)	415	417.147	1	0.945	0.331
2	Square Footage - Building (Quartiles - Less than 1468 sq. ft. as reference category)	415	417.07	3	1.021	0.7961
3	Square Footage - Unit (Quartiles - Trend)	415	418.077	1	0.014	0.9043
4	Square Footage - Unit (Quartiles - Less than 1350 sq. ft. as reference category)	415	416.601	3	1.491	0.6844
Tagging						
5	Tagging (Green Tags as reference category)	100	97.229	1	0.016	0.8991
6	Tagging (Untagged as reference category)	641	629.672	2	0.025	0.9875
Structure Construction Type						
7	Wood-Framed Structures (Missing, Other, Steel Frame, Concrete Frame, URM, Special as reference category)	641	628.322	1	1.375	0.2409
Year Built						
8	Year Built - Trend	413	412.978	1	1.461	0.2268
9	Year Built	413	411.363	3	3.076	0.38
Structure Use						
10	Multifamily Condos/Apts/Coops (Single Family & Duplexes as reference category)	393	394.936	1	2.23	0.1353
11	Use Coded (All Others as reference category)	641	629.69	1	0.0007	0.9327
All Structural Characteristics (Reduced Model)						
12*	Mx-fam Use, Year Built, Sq Ft Bldg, Sq Ft Unit	393	385.653	10	11.514	0.3189
13	Year Built, Sq Ft Bldg, Sq Ft Unit	393	391.398	9	5.769	0.7628
14	Mx-fam Use, Sq Ft Bldg, Sq Ft Unit	393	388.924	7	8.242	0.3117
15	Mx-fam Use, Year Built, Sq Ft Unit	393	389.831	7	7.335	0.3948
16	Mx-fam Use, Year Built, Sq Ft Bldg	393	386.335	7	10.832	0.1461
	Compare Model 13 to Model 12 (Mx-fam use | Year Built & Sq Ft)	393		1	5.745	p < 0.025
	Compare Model 14 to Model 12 (Yr Blt | Use, Sq Ft)	393		3	3.271	n.s.^
	Compare Model 15 to Model 12 (Sq Ft Bldg | Yr Blt, Use, Sq Ft	393		3	4.178	n.s.^
	Compare Model 16 to Model 12 (Sq Ft Unit | Yr Blt, Use, Sq Ft	393		3	0.682	n.s.^
Structural Characteristics (Reduced Model) with Interactions						
17	Use, Yr Blt, Sq Ft Bldg, Sq Ft Unit, Yr Blt * Use Interaction	393	381.315	11	15.852	0.1467
	Compare Model 17 to Model 12	393		1	4.338	p < 0.05

Table A-13. (Continued)

Model #	Model Variables	n	-2 * Log Likelihood	df	Chi-Sq. LRT^^	Chi-Sq. LRT p-value
Univariate:	Reduced Model (Structural Characteristics with Demographic Characteristics)					
18	Mx-fam Use	275	290.383	1	0.677	0.4107
19	Year Built	275	282.172	3	8.888	0.0308
20	Year Built Trend	275	286.044	1	5.016	0.0251
21	Gender	275	287.361	1	3.699	0.0544
22	Ethnicity	275	290.017	3	1.043	0.7909
23	Age Group	275	284.397	5	6.662	0.247
24	Age Group Trend	275	284.811	1	6.249	0.0124
25	Hospital	275	281.145	2	9.915	0.007
26**	Use, Yr Blt, Gender, Ethnic, Age Gp, Hospital	275	266.235	15	24.825	0.0523
26-t	Use, Yr Blt Trend, Gender, Ethnic, Age Gp, Hospital	275	269.491	13	21.568	0.0624
26-tt	Use, Yr Blt, Gender, Ethnic, Age Gp Trend, Hospital	275	266.654	11	24.406	0.0111
27	Gender Deleted from Model 26	275	267.523	14	23.537	0.0521
28	Ethnicity Deleted from Model 26	275	267.412	12	23.647	0.0227
29	Year Built Deleted from Model 26	275	273.155	12	17.905	0.1186
29-t	Year Built Trend Deleted from Model 26-t	275	273.155	12	17.905	0.1186
30	Structure Use Deleted from Model 26	275	267.505	14	23.555	0.0518
31	Hospital Deleted from Model 26	275	271.068	13	19.992	0.0954
32	Age Deleted from Model 26	275	269.127	10	21.933	0.0155
32-t	Age Group Trend Deleted from Model 26-tt	275	269.127	10	21.933	0.0155
	Compare Model 27 to 26 (Gender | Use, Yr Blt, Age, Ethnic, Hosp.)	275		1	1.288	n.s.^
	Compare Model 28 to 26 (Ethnicity | Use, Yr Blt, Age, Gender,	275		2	1.178	n.s.^
	Compare Model 29 to 26 (Yr Built | Use, Gender, Age, Ethnic,	275		3	6.92	n.s.^
	Compare Model 29-t to 26-t (Yr Built Trend| Use, Gender, Age, Ethnic, Hosp.)	275		1	3.663	n.s.^
	Compare Model 30 to 26 (Use | Yr Blt, Age Gp, Ethnic, Gender,	275		1	1.27	n.s.^
	Compare Model 31 to 26 (Hospital | Use, Yr Blt, Gender, Ethnic, Age, Hosp)	275		2	4.833	n.s.^
	Compare Model 32 to 26 (Age | Use, Yr Blt, Gender, Ethnic, Hosp)	275		5	2.892	n.s.^
	Compare Model 32-t to 26-tt (Age Trend | Use, Yr Blt, Gender, Ethnic, Hosp)	275		1	2.473	n.s.^
Interaction						
33	Model 26 with Use * Year Built Interaction	275	265.859	16	25.2	0.0664
34***	Model 26 with Dummy Interaction Variables	275	263.264	18	27.795	0.0652
34-t	Model 34 with Year Built Trend	275	268.166	16	22.893	0.1166
34-tt	Model 34 with Age Group Trend	275	263.698	14	27.362	0.0173
	Compare Model 33 to 26	275		2	0.375	n.s.^
	Compare Model 34 to 26	275		3	2.97	n.s.^

Table A-13. (Continued)

Model #	Model Variables	n	-2 * Log Likelihood	df	Chi-Sq. LRT^^	Chi-Sq. LRT p-value
Reduced Model with Tagging Information Included with Previously Identified Stat. Signif. Structural Variables						
35	Mx-fam, Yr Blt, Red & Yellow Tags	59	57.862	5	4.364	0.4983
36	Model 35 with Demographics	59	38.462	16	23.763	0.0948
	Compare Model 36 to Model 35	59		11	19.4	n.s.^

^ n.s.=not statistically significant (p > 0.05)
^^LRT=Likelihood Ratio Test; for interaction models 17,33,34, Chi-Square LRT on 1 df=difference in likelihoods from interaction model versus model 12, 26, 26, respectively.
* Core Model, Structural Characteristics
** Final Model, Structural Characteristics with Demographics
*** Final Model, with Interaction.

Table A-14. Polytomous Logistic Regression: Geologic Characteristics Model Development.

Model #	Model Variables	n	-2 * Log Likelihood	df	Chi-Sq. LRT	Chi-Sq. LRT p-value	Chi-Sq. Prop. Odds Assump p-value
1	Soil Groups (Rock as reference category)	419	508.816	2	3.286	0.1934	0.0619
2	Liquefiable vs. All Other	419	508.984	1	3.118	0.0774	0.254
	Compare Model 2 with Model 1			1	0.168	n.s.	
3	MMI (Trend Levels VI - IX)	415	515.717	1	0.146	0.7028	0.4552
4	MMI (Levels VIII & IX vs. VI & VII)	415	515.535	1	0.328	0.5669	0.7133
5	PGA (Trend - Quartiles)	420	516.927	1	1.213	0.2708	0.1676
6	PGA as Continuous Variable	420	515.835	1	2.304	0.129	0.1581
7	PGA (< 0.62 g as reference category)	420	512.198	3	5.942	0.1145	0.4472
8*	MMI (Dichotomous), Liquefiable Soil, & PGA Quartiles	414	500.45	5	9.399	0.0942	0.4546
9	MMI (Dichotomous), Liquefiable Soil, & PGA (Trend)	414	505.378	3	4.472	0.2148	0.3353
10	MMI	414	509.623	1	0.227	0.6341	0.6007
11	Liquefaction	414	507.079	1	2.77	0.096	0.2562
12	PGA Quartile	414	503.101	3	6.749	0.0804	0.5103
13	MMI (Dichotomous), Liquefiable Soil	414	506.865	2	2.985	0.2248	0.4514
14	PGA Quartiles & MMI	414	501.011	4	8.838	0.0653	0.6459
15	PGA Quartiles & Liquefiable Soil	414	502.348	4	7.501	0.1117	0.3594
	Compare Model 13 with Model 8 (PGA | MMI & Liquefaction)	414		3	6.414	n.s.	
	Compare Model 14 with Model 8 (Liquefaction | PGA & MMI)	414		1	0.561	n.s.	
	Compare Model 15 with Model 8 (MMI | PGA & Liquefaction)	414		1	1.898	n.s.	
NO INTERACTION TERMS (Insufficient observations in polytomous model)							
Geologic Characteristics with Demographics							
16	MMI	279	369.181	1	0.278	0.5982	0.4407
17	Liquefaction	279	369.137	1	0.322	0.5702	0.3521
18	PGA Quartiles	279	365.149	3	4.31	0.2299	0.5686
18-t	PGA Trend	279	369.452	1	0.007	0.9324	0.1659

Table A-14. (Continued)

Model #	Model Variables	n	-2 * Log Likelihood	df	Chi-Sq. LRT	Chi-Sq. LRT p-value	Chi-Sq. Prop. Odds Assump p-value
19	Gender	279	364.666	1	4.793	0.0286	0.4293
20	Ethnicity	279	369.373	2	0.086	0.9578	0.4501
21	Age Group	279	360.161	5	9.298	0.0978	0.0608
21-t	Age Group Trend	279	360.313	1	9.146	0.0025	0.0491
22	Hospital	279	358.294	2	11.165	0.0038	0.4241
23**	MMI, Liquefaction, PGA Quartiles, Gender, Ethnic, Age, Hospital	279	336.56	15	32.899	0.0048	0.3803
24-t1	MMI, Liquefaction, PGA Trend, Gender, Ethnic, Age, Hospital	279	340.419	13	29.04	0.0065	0.274
24-t2	MMI, Liquefaction, PGA Quartiles, Gender, Ethnic, Age Trend,	279	337.318	11	32.142	0.0007	0.519
25	Deleted Gender from Model 23	279	337.804	14	31.655	0.0045	0.2979
26	Deleted Ethnicity from Model 23	279	337.539	13	31.92	0.0025	0.2662
27	Deleted Age from Model 23	279	343.034	10	26.425	0.0032	0.8064
28	Deleted Soil Type from Model 23	279	336.746	14	32.713	0.0032	0.5411
29	Deleted MMI from Model 23	279	338.76	14	30.699	0.0061	0.2912
30	Deleted PGA from Model 23	279	347.315	12	22.145	0.0359	0.2263
31	Deleted Hospital from Model 23	279	352.765	13	16.694	0.2137	0.3876
	Compare Model 25 to 23 (Gender | Ethnic, Age, Soil, MMI, PGA,	279		1	1.244	n.s.	
	Compare Model 26 to 23 (Ethnic | Gender, Age, Soil, MMI, PGA,	279		2	0.979	n.s.	
	Compare Model 27 to 23 (Age | Ethnic, Gender, Soil, MMI, PGA,	279		5	6.474	n.s.	
	Compare Model 28 to 23 (Soil | Ethnic, Age, Gender, MMI, PGA,	279		1	0.186	n.s.	
	Compare Model 29 to 23 (MMI | Ethnic, Age, Soil, Gender, PGA,	279		1	2.2	n.s.	
	Compare Model 30 to 23 (PGA | Ethnic, Age, Soil, MMI, Gender,	279		3	10.754	$p < 0.025$	
	Compare Model 31 to 23 (Hosp | Ethnic, Age, Soil, MMI, PGA,	279		2	16.205	$p < 0.0005$	

*Core Geologic Characteristics
**Core Geologic Characteristics with Demographics

Table A-15. Model Development: Dichotomous Logistic Regression, Geologic Characteristics and Demographics with Respect to Injury Severity.

Model #	Model Variables	n	-2 * Log Likelihood	df	Chi-Sq. LRT	Chi-Sq. LRT p-value
1	Soil Groups (Rock as reference category)	419	416.195	2	3.696	0.1576
2	Liquefiable vs. All Other	419	416.558	1	3.333	0.0679
	Compare Model 2 with Model 1			1	0.363	n.s.
3	MMI (Trend Levels VI - IX)	415	420.722	1	0.097	0.755
4	MMI (Levels VIII & IX vs. VI & VII)	415	420.453	1	0.367	0.5449
5	PGA (Trend - Quartiles)	420	422.193	1	0.903	0.3419
6	PGA (< 0.62 g as reference category)	420	417.582	3	5.514	0.1378
7	PGA as Continuous Variable	420	421.219	1	1.877	0.1707
8*	MMI (Dichotomous), Liquefiable Soil, & PGA Quartiles	414	408.745	5	8.894	0.1134
9	MMI (Dichotomous), Liquefiable Soil, & PGA (Trend)	414	413.266	3	4.373	0.2239
10	MMI	414	417.365	1	0.274	0.6007
11	Liquefaction	414	414.659	1	2.98	0.0843
12	PGA Quartile	414	411.357	3	6.282	0.0987
13	PGA Trend	414	417.075	1	0.563	0.4529
14	MMI (Dichotomous), Liquefiable Soil	414	414.401	2	3.238	0.1981
15	PGA Quartiles & MMI	414	409.439	4	8.2	0.0845
16	PGA Quartiles & Liquefiable Soil	414	410.461	4	7.177	0.1268
	Compare Model 14 with Model 8 (PGA | MMI & Liquefaction)	414		3	5.656	n.s.
	Compare Model 15 with Model 8 (Liquefaction | PGA & MMI)	414		1	0.694	n.s.
	Compare Model 16 with Model 8 (MMI | PGA & Liquefaction)	414		1	1.717	n.s.
NO INTERACTION TERMS (Insufficient observations in polytomous model)						
Geologic Characteristics with Demographics						
17	MMI	295	310.269	1	0.86	0.3538
18	Liquefaction	295	310.535	1	0.594	0.441
19	PGA Quartiles	295	306.625	3	4.504	0.212
20	PGA Trend	295	311.068	1	0.061	0.8049
21	Gender	295	306.195	1	4.934	0.0263
22	Ethnicity	295	310.007	3	1.121	0.7719
23	Age Group	295	302.407	5	8.722	0.1207
24	Age Group Trend	295	303.238	1	7.891	0.005
25	Hospital	295	298.758	2	12.371	0.0021
26**	MMI, Liquefaction, PGA Quartiles, Gender, Ethnic, Age, Hospital	295	280.369	16	30.76	0.0144
27	MMI, Liquefaction, PGA Trend, Gender, Ethnic, Age, Hospital	295	283.537	14	27.591	0.0161
28	MMI, Liquefaction, PGA Quartiles, Gender, Ethnic, Age Trend, Hospital	295	281.569	12	29.56	0.0033

Table A-15. (Continued)

Model #	Model Variables	n	-2 * Log Likelihood	df	Chi-Sq. LRT	Chi-Sq. LRT p-value
29	Deleted Gender from Model 26	295	281.612	15	29.517	0.0138
30	Deleted Ethnicity from Model 26	295	281.813	13	29.316	0.0059
31	Deleted Age from Model 26	295	285.652	11	25.476	0.0078
32	Deleted Soil Type from Model 26	295	280.418	15	30.711	0.0096
33	Deleted MMI from Model 26	295	282.367	15	28.762	0.0173
34	Deleted PGA from Model 26	295	287.904	13	23.225	0.0391
35	Deleted Hospital from Model 26	295	293.634	14	17.495	0.2308
	Compare Model 29 to 26 (Gender | Ethnic, Age, Soil, MMI, PGA, Hosp)	295		1	1.243	n.s.
	Compare Model 30 to 26 (Ethnic | Gender, Age, Soil, MMI, PGA, Hosp)	279		3	1.444	n.s.
	Compare Model 31 to 26 (Age | Ethnic, Gender, Soil, MMI, PGA, Hosp)	279		5	5.284	n.s.
	Compare Model 32 to 26 (Soil | Ethnic, Age, Gender, MMI, PGA, Hosp)	279		1	0.049	n.s.
	Compare Model 33 to 26 (MMI | Ethnic, Age, Soil, Gender, PGA, Hosp)	279		1	1.998	n.s.
	Compare Model 34 to 26 (PGA | Ethnic, Age, Soil, MMI, Gender, Hosp)	279		3	7.535	n.s.
	Compare Model 35 to 26 (Hosp | Ethnic, Age, Soil, MMI, PGA, Gender)	279		2	13.265	$p < 0.005$

*Core Geologic Characteristics
**Core Geologic Characteristics with Demographics

Table A-16. Polytomous Logistic Regression: Model Development, Demographics, Injury, Geologic, Structural Characteristics Associated with Injury Severity

Model #	Model Variables	n	-2 * Log Likelihood	df	Chi-Sq. LRT	Chi-Sq. LRT p-value	Chi-Sq. Prop. Odds Assump p-value
Demographics (Univariate)							
1	Gender	196	232.435	1	4.15	0.0416	0.2438
2	Ethnicity	196	235.722	2	0.864	0.6493	0.6778
3	Age Group	196	228.561	5	8.025	0.1549	0.2004
3-t	Age Group Trend	196	229.79	1	6.796	0.0091	0.0829
Injury Characteristics (Univariate)							
4	Body Location	196	234.347	3	2.239	0.5243	0.5868
5	Mechanism of Injury (Falls vs. Struck/Cut/Caught by)	196	216.764	1	19.821	0.0001	0.4051
Structural Characteristics (Univariate)							
6	Use (multi-family residence vs. single/duplex residence)	196	233.396	1	3.19	0.0741	0.7166
7	Year Built Group	196	233.145	3	3.441	0.3285	0.6192
7-t	Year Built Group Trend	196	234.348	1	2.238	0.1347	0.2334
Geologic Characteristics (Univariate)							
8	MMI (dichotomous)	196	236.535	1	0.051	0.8213	0.266
9	Soil Type (Liquefiable vs. all other)	196	236.552	1	0.034	0.8539	0.9354
10	PGA (dichotomous)	196	236.295	1	0.29	0.59	0.5158
Hospital (Univariate)							
11	Level I Trauma Centers w.r.t. all others	196	231.847	2	4.738	0.0936	0.9152
Full Model							
12*	Gender, Ethnicity, Age, Body Location, Mechanism of Injury, Structure Use, Year Built, MMI, Soil Type, PGA, Hospital	196	182.178	21	54.408	0.0001	0.3601
12-t1	Gender, Ethnicity, Age Group Trend, Body Location, Mechanism of Injury, Structure Use, Year Built, MMI, Soil Type, PGA, Hospital	196	188.333	17	48.253	0.0001	0.3895
12-t2	Gender, Ethnicity, Age, Body Location, Mechanism of Injury, Structure Use, Year Built Trend, MMI, Soil Type, PGA, Hospital	196	182.969	19	53.617	0.0001	0.4414

Table A-16. (Continued)

Model #	Model Variables	n	-2 * Log Likelihood	df	Chi-Sq. LRT	Chi-Sq. LRT p-value	Chi-Sq. Prop. Odds Assump p-value
Partial Models							
13	Deleted Gender from Model 12	196	182.591	20	53.995	0.0001	0.3318
14	Deleted Ethnicity from Model 12	196	183.534	19	53.052	0.0001	0.6222
15	Deleted Age from Model 12	196	193.08	16	43.506	0.0002	0.23
16	Deleted Body Location from Model 12	196	185.912	18	50.673	0.0001	0.3777
17	Deleted Mechanism from Model 12	196	195.83	20	40.756	0.004	0.2076
18	Deleted Structure Use from Model 12	196	190.761	20	45.825	0.0009	0.5754
19	Deleted Year Built from Model 12	196	187.393	18	49.192	0.0001	0.6134
20	Deleted MMI from Model 12	196	185.116	20	51.47	0.0001	0.2527
21	Deleted Soil Type from Model 12	196	182.374	20	54.211	0.0001	0.4048
22	Deleted PGA from Model 12	196	198.84	20	37.745	0.0095	0.2687
23	Deleted Hospital from Model 12	196	190.231	19	46.355	0.0004	0.3161
	Compare Model 13 to 12 (Gender | All other variables)	196		1	0.413	n.s.	
	Compare Model 14 to 12 (Ethnicity | All other variables)	196		2	1.356	n.s.	
	Compare Model 15 to 12 (Age | All other variables)	196		5	10.902	n.s.	
	Compare Model 16 to 12 (Age | All other variables)	196		3	3.735	n.s.	
	Compare Model 17 to 12 (Mechanism | All other variables)	196		1	13.652	$p < 0.0005$	
	Compare Model 18 to 12 (Structure | All other variables)	196		1	8.583	$p < 0.005$	
	Compare Model 19 to 12 (Year Built | All other variables)	196		3	5.216	n.s.	
	Compare Model 20 to 12 (MMI | All other variables)	196		1	2.938	n.s.	
	Compare Model 21 to 12 (Soil Type | All other variables)	196		1	0.197	n.s.	
	Compare Model 22 to 12 (PGA | All other variables)	196		1	16.663	$p < 0.0005$	
	Compare Model 23 to 12 (Hospital | All other variables)	196		1	8.053	$p < 0.005$	
Interaction							
24**	Gender, Ethnicity, Age Group, Body Location, External Cause, Structure Use, Year of Construction, Interaction between Structure Use & Year of Construction, MMI, Liquefiable Soil, PGA	196	180.952	24	55.634	0.0003	0.4496

Table A-16. (Continued)

Model #	Model Variables	n	-2 * Log	df	Chi-Sq.	Chi-Sq. LRT	Chi-Sq. Prop.
24-t1	Gender, Ethnicity, Age Group Trend, Body Location, External Cause, Structure Use, Year of Construction, Interaction between Structure Use & Year of Construction, MMI, Liquefiable Soil, PGA	196	187.1	20	49.485	0.0003	0.5148
24-t2	Gender, Ethnicity, Age Group, Body Location, External Cause, Structure Use, Year Built Trend, Interaction between Structure Use & Year of Construction, MMI, Liquefiable Soil, PGA	196	181.389	22	55.197	0.0001	0.4436
	Compare Model 35 to 12 (Interaction | All other variables)	196		2	1.226	n.s.	
Partial Models with Interactions							
25	Deleted Gender from Model 24	196	181.198	23	55.388	0.0002	0.3955
26	Deleted Ethnicity from Model 24	196	182.48	22	54.106	0.0002	0.7864
27	Deleted Age from Model 24	196	192.727	19	43.858	0.001	0.3478
28	Deleted Body Location from Model 24	196	184.88	21	51.706	0.0002	0.5315
29	Deleted Mechanism from Model 24	196	194.896	23	41.689	0.0099	0.3145
30	Deleted Structure Use from Model 24	196	182.068	23	54.518	0.0002	0.4082
31	Deleted Year Built from Model 24	196	181.911	21	54.675	0.0001	0.6272
32	Deleted MMI from Model 24	196	183.634	23	52.952	0.0004	0.329
33	Deleted Soil Type from Model 24	196	181.045	23	55.54	0.0002	0.5597
34	Deleted PGA from Model 24	196	196.515	23	40.071	0.0151	0.3687
35	Deleted Hospital from Model 24	196	189.171	22	47.414	0.0013	0.3717
	Compare Model 25 to 24 (Gender | All other variables)	196		1	0.246	n.s.	
	Compare Model 26 to 24 (Ethnicity | All other variables)	196		2	1.528	n.s.	
	Compare Model 27 to 24 (Age | All other variables)	196		5	11.776	$p < 0.05$	
	Compare Model 28 to 24 (Body Location | All other variables)	196		3	3.928	n.s.	
	Compare Model 29 to 24 (Mechanism | All other variables)	196		1	13.945	$p < 0.0005$	
	Compare Model 30 to 24 (Structure Use | All other variables)	196		1	1.116	n.s.	
	Compare Model 31 to 24 (Year Built | All other variables)	196		3	0.959	n.s.	
	Compare Model 32 to 24 (MMI | All other variables)	196		1	2.682	n.s.	
	Compare Model 33 to 24 (Soil Type | All other variables)	196		1	0.094	n.s.	
	Compare Model 34 to 24 (PGA | All other variables)	196		1	15.563	$p < 0.0005$	
	Compare Model 35 to 24 (Hospital | All other variables)	196		2	8.22	$p < 0.025$	

Table A-17. Model Development: Dichotomous Logistic Regression, Demographics, Injury, Structural & Geologic Characteristics with Respect to Moderate and Severe Injury.

Model #	Model Variables	n	-2 * Log Likelihood	df	Chi-Sq. LRT	Chi-Sq. LRT p-value
Demographics (Univariate)						
1	Gender	230	237.387	1	3.463	0.0628
2	Ethnicity	230	240.545	3	0.305	0.9592
3	Age Group	230	234.439	5	6.411	0.2683
4	Age Group Trend	230	234.736	1	6.113	0.0134
Injury Characteristics (Univariate)						
5	Body Location	230	235.79	3	5.059	0.1675
6	Mechanism of Injury	230	209.03	6	31.819	0.0001
Structural Characteristics (Univariate)						
7	Structure Use	230	239.642	1	1.208	0.2717
8	Year Built Group	230	234.135	3	6.714	0.0816
9	Year Built Group Trend	230	235.545	1	5.305	0.0213
Geologic Characteristics (Univariate)						
10	MMI	230	240.1	1	0.750	0.3866
11	Soil Type (Liquefiable vs. all other)	230	240.85	1	0.000	1.0000
12	PGA (quartiles)	230	239.078	3	1.771	0.6212
12-t	PGA Trend	230	240.389	1	0.461	0.4971
Hospital (Univariate)						
13	Level I Trauma Centers w.r.t. all others	230	231.546	2	9.304	0.0095
Full Model, no Interactions						
14	Gender, Ethnicity, Age, Body Location, Mechanism of Injury, Structure Use, Year Built, MMI, Soil Type, PGA, Hospital	230	179.072	29	61.778	0.0004
15	Gender, Ethnicity, Age Group Trend, Body Location, Mechanism of Injury, Structure Use, Year Built, MMI, Soil Type, PGA, Hospital	230	182.455	25	58.395	0.0002
16	Gender, Ethnicity, Age, Body Location, Mechanism of Injury, Structure Use, Year Built Trend, MMI, Soil Type, PGA, Hospital	230	179.416	27	61.434	0.0002
Partial Models						
17	Deleted Gender from Model 14	230	179.104	28	61.746	0.0002
18	Deleted Ethnicity from Model 14	230	179.904	26	60.946	0.0001
19	Deleted Age from Model 14	230	184.601	24	56.249	0.0002
20	Deleted Body Location from Model 14	230	186.504	26	54.346	0.0009
21	Deleted Mechanism from Model 14	230	204.786	23	36.064	0.0406
22	Deleted Structure Use from Model 14	230	183.116	28	57.734	0.0008
23	Deleted Year Built from Model 14	230	183.393	26	57.457	0.0004
24	Deleted MMI from Model 14	230	182.306	28	58.544	0.0006
25	Deleted Soil Type from Model 14	230	179.893	28	60.956	0.0003
26	Deleted PGA from Model 14	230	189.905	26	50.945	0.0024
27	Deleted Hospital from Model 14	230	186.508	27	54.341	0.0014
	Compare Model 17 to 14 (Gender | All other variables)	230		1	0.032	n.s.
	Compare Model 18 to 14 (Ethnicity | All other variables)	230		3	0.832	n.s.
	Compare Model 19 to 14 (Age | All other variables)	230		5	5.529	n.s.
	Compare Model 20 to 14 (Age | All other variables)	230		3	7.432	n.s.
	Compare Model 21 to 14 (Mechanism | All other variables)	230		6	25.714	$p < 0.0005$
	Compare Model 22 to 14 (Structure | All other variables)	230		1	4.044	$p < 0.05$

Table A-17. (Continued)

Model #	Model Variables	n	-2 * Log Likelihood	df	Chi-Sq. LRT	Chi-Sq. LRT p-value
	Compare Model 23 to 14 (Year Built | All other variables)	230		3	4.321	n.s.
	Compare Model 24 to 14 (MMI | All other variables)	230		1	3.234	n.s.
	Compare Model 25 to 14 (Soil Type | All other variables)	230		1	0.822	n.s.
	Compare Model 26 to 14 (PGA | All other variables)	230		3	10.833	p < 0.025
	Compare Model 27 to 14 (Hospital | All other variables)	230		2	7.437	n.s.
Interaction						
28**	Gender, Ethnicity, Age Group, Body Location, External Cause, Structure Use, Year of Construction, Interaction between Structure Use & Year of Construction, MMI, Liquefiable Soil, PGA	230	178.255	32	62.595	0.0010
29	Gender, Ethnicity, Age Group Trend, Body Location, External Cause, Structure Use, Year of Construction, Interaction between Structure Use & Year of Construction, MMI, Liquefiable Soil, PGA	230	181.642	28	59.207	0.0005
30	Gender, Ethnicity, Age Group, Body Location, External Cause, Structure Use, Year Built Trend, Interaction between Structure Use & Year of Construction, MMI, Liquefiable Soil, PGA	230	179.224	30	61.626	0.0006
	Compare Model 28 to 14 (Interaction | All other variables)	230		3	0.817	n.s.
Partial Models with Interactions						
31	Deleted Gender from Model 28	230	178.274	31	62.576	0.0007
32	Deleted Ethnicity from Model 28	230	179.142	29	61.708	0.0004
33	Deleted Age from Model 28	230	183.839	27	57.011	0.0006
34	Deleted Body Location from Model 28	230	185.424	29	55.426	0.0022
35	Deleted Mechanism from Model 28	230	203.307	26	37.542	0.0667
36	Deleted Structure Use from Model 28	230	179.536	31	61.314	0.0009
37	Deleted Year Built from Model 28	230	180.469	29	60.381	0.0006
38	Deleted MMI from Model 28	230	180.806	31	60.044	0.0013
39	Deleted Soil Type from Model 28	230	179.115	31	61.735	0.0008
40	Deleted PGA from Model 28	230	188.077	29	52.772	0.0045
41	Deleted Hospital from Model 28	230	185.9	30	54.950	0.0036
	Compare Model 31 to 28 (Gender | All other variables)	230		1	0.019	n.s.
	Compare Model 32 to 28 (Ethnicity | All other variables)	230		3	0.887	n.s.
	Compare Model 33 to 28 (Age | All other variables)	230		5	5.584	n.s.
	Compare Model 34 to 28 (Body Location | All other variables)	230		3	7.169	n.s.
	Compare Model 35 to 28 (Mechanism | All other variables)	230		6	25.053	p < 0.0005
	Compare Model 36 to 28 (Structure Use | All other variables)	230		1	1.281	n.s.
	Compare Model 37 to 28 (Year Built | All other variables)	230		3	2.214	n.s.
	Compare Model 38 to 28 (MMI | All other variables)	230		1	2.551	n.s.
	Compare Model 39 to 28 (Soil Type | All other variables)	230		1	0.860	n.s.
	Compare Model 40 to 28 (PGA | All other variables)	230		3	9.823	p < 0.025
	Compare Model 41 to 28 (Hospital | All other variables)	230		2	7.645	p < 0.025